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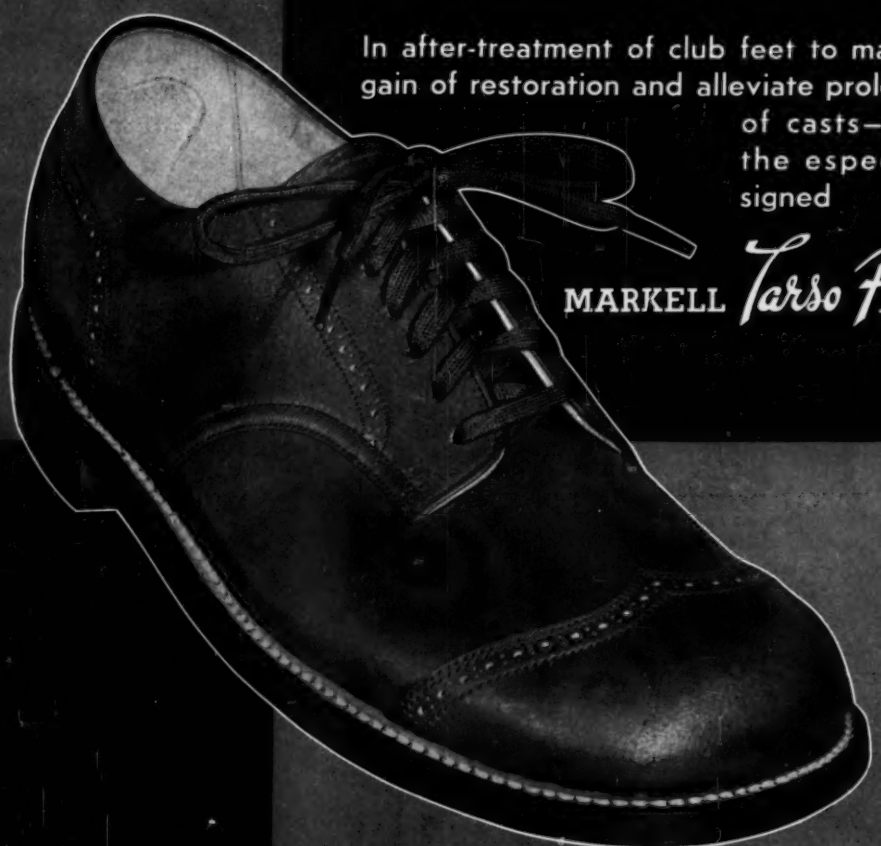

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VOL. XX, NO. 4 OCTOBER, 1938 Old Series Vol. XXXVI, No. 4

The Journal of
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TREATMENT OF SCOLIOSIS BY THE WEDGING JACKET AND SPINE FUSION

A Review of 265 Cases *

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Director of Roentgenology

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The first spine-fusion operation for scoliosis in the New York Orthopaedic Dispensary and Hospital was performed in 1914. In 1931, Hibbs, Risser, and Ferguson reported the results in the first 360 patients so treated, covering the thirteen years from 1914 to 1927. The present report embraces 301 patients who were operated upon from 1928 to 1935, inclusive, and continues the study of all cases of lateral curvature treated by fusion in the Hospital through 1935. This latter period coincides approximately with that during which the wedging jacket, devised by Risser, has been used in correcting scoliosis, and thus enables us to compare the results of treatment by this means with those obtained by the older methods of simple traction and traction jackets. Two hundred and sixty-five patients had been treated by the wedging jacket at the end of 1935. The present study deals chiefly with them. It convinces us of the marked superiority of this over other methods of correcting scoliosis, and confirms our belief that fusion of the spine in the right area will maintain correction of a curve, after a slight initial loss in some cases.

The use of the wedging jacket, followed by spine fusion, is a difficult procedure, demanding a thorough understanding of all principles involved and the closest attention to many details, the neglect of any one of which

* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 5, 1938.

may result in marring the outcome or in complete failure. Unless one is willing to master all of these points thoroughly and to do all of the hard work entailed, he had better not undertake it at all. Although it is possible for a surgeon working alone to carry out this method of treatment, yet if many patients are to be treated, it is of great advantage to have an experienced team, including an orthopaedic surgeon who can devote the major part of his time to the task, a roentgenologist who understands the special details of the problem, and nurses who have been trained to care for the patients in their jackets.

Correction of the curve and a fusion operation are not advised in all cases of scoliosis. In the eight-year period covered by this study, 1498 new cases of scoliosis were seen in our Clinic and only 287 patients, or 19 per cent. of the entire number, were operated upon. Additional experience confirms our belief that increase in a curve is coincident with growth of the spine, and that when the latter stops the curve reaches a static condition.[4] The following are the more important indications for correction and fusion:

1. A curve which is progressing, in a growing child.
2. A severe curve with imbalance of the trunk, whether or not the patient is beyond the period of growth.
3. A deformity which is causing pain or fatigue. In some of these cases an operation may be performed without previous correction.

At our Hospital the routine management of a patient with scoliosis begins by referring him to the special scoliosis clinic. A history is taken and an examination is made, including measurements of total height, of sitting height, and of the length of the lower extremities. In many cases a study of the vital capacity is made. Roentgenograms are made of the spine in the standing and in the lying positions, from which the curves are measured, and photographs are taken. If it is obvious that correction and operation are necessary, this is advised after the examinations have been completed. In the majority of cases, further observation is indicated in order to determine whether or not the curve is progressing. During this time, exercises are carried out in the gymnasium, not with any intention of correcting or arresting the deformity thereby, but in order to improve posture and to hold the patient's interest until it is decided whether or not any other treatment is necessary. In three patients a measurable improvement did occur after corrective exercises.

FIG. 1

Jacket before cutting and wedging. Patient with right thoracolumbar curve.

The jacket now employed is essentially

the same as that first used by Risser in 1927 and described by him in 1931[3]. It has been modified in a few details, the most important of which is that it now is applied with only enough traction to hold the head in position and without depending upon this force for any correction. During the application of the jacket, the head is held toward the side of the concavity of the curve. This is done in order to prevent undue stretching of the brachial plexus, which was a troublesome complication in some patients before this expedient was adopted. The hinges are now placed more eccentrically toward the convexity of the curve, and it is not considered necessary to have them opposite the center, especially in the thoracic region. In these cases they often are below the center or apex.

FIG. 2

Jacket during process of wedging.

FIG. 3

Front view of jacket at same stage as that shown in Fig. 2.

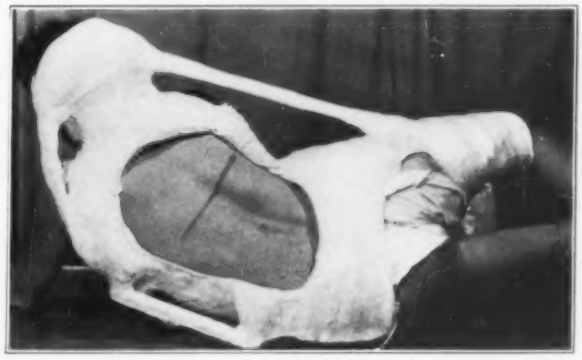

FIG. 4

Jacket after completion of wedging, prepared for the operation.

The greater ease by which a curved rod can be straightened by bending it, rather than by making traction upon its ends, can be demonstrated mathematically as well as by practical test. In addition to its greater effectiveness in straightening the primary curve, the wedging jacket has the great advantage of simultaneously increasing the compensatory curve. This change in the secondary curve is maintained, of course, only while the patient is in the jacket. After the latter has been

FIG. 5

Case 1. Patient aged ten years. Before treatment.

FIG. 6

Case 1. Six years after operation.

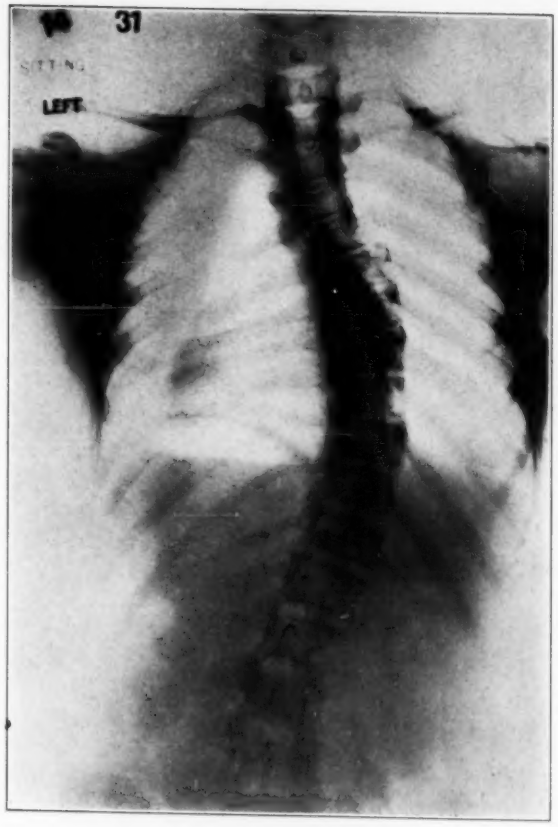

FIG. 9

Case 1. Roentgenogram of patient sitting. Before operation.

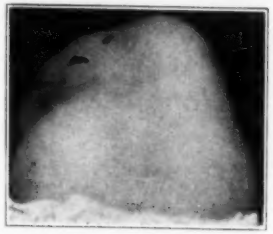

FIG. 7

Case 1. Forward bending before operation.

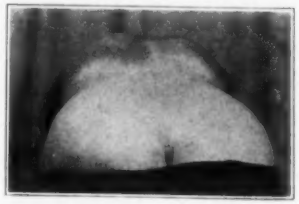

FIG. 8

Case 1. Forward bending after operation. Note correction of rotation.

removed, the compensatory curve should straighten in proportion to the degree that the primary curve has been corrected.

This temporary increase in the secondary curve is of great importance, however, and is one of the main factors contributing to the success of this jacket. It means that, in cases in which the primary curve can be corrected only partially, body balance still can be reestablished and marked clinical improvement can be obtained by continuing the fusion a few vertebrae beyond the primary curve into the secondary one. In this way patients with severe curves of long standing, some of which can be corrected to only a small degree, can be greatly helped and their appearance markedly improved.

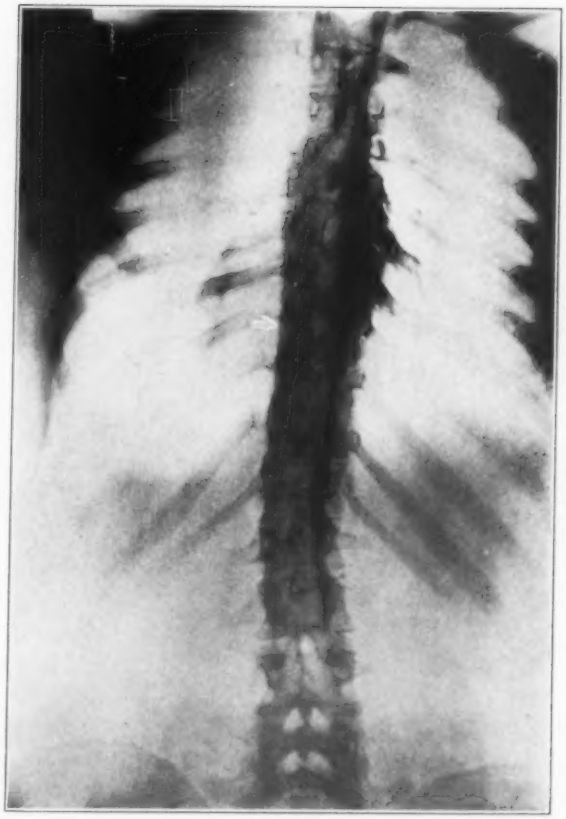

FIG. 10

Case 1. Roentgenogram of patient sitting. Six years after operation.

Identification of the primary curve is, of course, necessary before the application of the jacket. Usually this presents little difficulty, but in some cases it may be a puzzling problem. Ferguson has described the criteria which are used in this determination, and only the more elementary rules are repeated here:

1. In the case of three curves, the middle one usually is the primary curve.

2. The greater curve, or the one toward which the trunk is shifted, usually is the primary curve.

3. When, in the sitting position, the pelvis is elevated on the side of the convexity of the lumbar curve, if this curve is compensatory, it will tend to straighten; but, if it is primary, it will not.

Another important matter is the selection of the area of the spine to be fused. This phase of the procedure has been described fully in previous articles.[1] After the curve has been corrected to the extent possible or desired, the jacket is prepared for the operation. It is first reinforced

FIG. 11

Case 2. Patient aged five years. Before treatment.

FIG. 12

Case 2. Four years after operation.

FIG. 13

Case 2. Forward bending before operation.

FIG. 14

Case 2. Forward bending after operation, showing correction of rotation.

FIG. 15

Case 2. Roentgenogram of patient standing. Before operation.

with struts constructed of basswood and plaster. A snugly fitting vest of plaster is then applied. Finally, a window is removed from the back in the region to be operated upon. A transverse mark is made with gentian-violet stain on the skin over one of the spinous processes. A wire is placed on this, and a roentgenogram is taken. Without a mark of this kind, it would be impossible to ascertain exactly which vertebrae are being operated upon. A mistake of even one vertebra in the area of fusion in many cases would have a serious effect upon the result.

FIG. 16

Case 2. Roentgenogram of patient standing. Five years after operation.

The same roentgenogram is used in determining the limits of the fusion:

1. If the primary curve has been straightened completely, the fusion is limited to the vertebrae included in it. It is important that the end vertebrae be not overcorrected, which might occur in a mild flexible curve.

2. When correction is not complete, it may be advisable to extend the fusion beyond the limits of the primary curve. The objective should be to extend the fusion to the point where the upper surface of the upper vertebra will be parallel to the lower surface of the lower vertebra. These surfaces should be at right angles to a line joining their centers. The time required for correction of the curve, including the application of the jacket and its preparation for the operation, is from three to four weeks.

The Hibbs method of fusion was used in all cases. If more than five vertebrae are to be included in the fusion, the operation is done in two or more stages. Since this rule was adopted, the occurrence of shock has been minimized and the mortality has been reduced from 1.9 to 0.66 per cent. An intravenous infusion of glucose is given during the operation and, if necessary, a blood transfusion is given afterward. The latter sel-

dom is needed, but is used for less serious indications now than formerly. The postoperative course usually is uneventful and in the great majority of cases is not attended by a marked rise in the temperature or in the pulse rate.

The patient remains in the original jacket for three months after the last operation, and during this time is kept in bed. The jacket is then removed and a so-called "semibent" jacket is applied. It is put on with the patient lying supine on a strip of canvas and without any attempt to straighten the back more than occurs naturally. A strap of plaster is included over the shoulder opposite the curve in order to hold the head and neck over. Since the compensatory curve does not straighten fully, the patient still is bent over toward the side of the primary curve. The patient is now permitted to be up. At the end of three more months, the jacket is again changed, and the shoulder strap which was incorporated in the semibent jacket is omitted. When the last jacket is put on, the spine usually has nearly but not completely become straight. This jacket is removed in three months and, if the roentgenograms indicate that the fusion is continuous and mature, no other plaster is applied. The strength of the fusion is judged in relation to the size of the patient and the amount of correction that has been obtained. Therefore, the question of whether jackets shall be continued longer than nine months after the operation must be decided from the factors in each case.

A roentgenographic examination should be made each time the jacket is changed in order to detect at the earliest possible moment any

FIG. 17

Case 3. Patient aged nineteen years. Before treatment.

FIG. 18

Case 3. Patient at completion of treatment.

FIG. 19

Case 3. Roentgenogram of patient standing. Before treatment.

FIG. 20

Case 3. Roentgenogram nine months after correction and fusion. Loss of correction has occurred between the first and second lumbar vertebrae, due to pseudarthrosis.

FIG. 21

Case 3. Roentgenogram three years later than Fig. 20. Correction was regained in the jacket, and pseudarthrosis was repaired.

FIG. 22

Case 4. Patient with left thoracolumbar curve. Before operation.

FIG. 23

Case 4. Three years after correction and spine fusion.

FIG. 24

Case 4. Roentgenogram of patient standing. Before treatment.

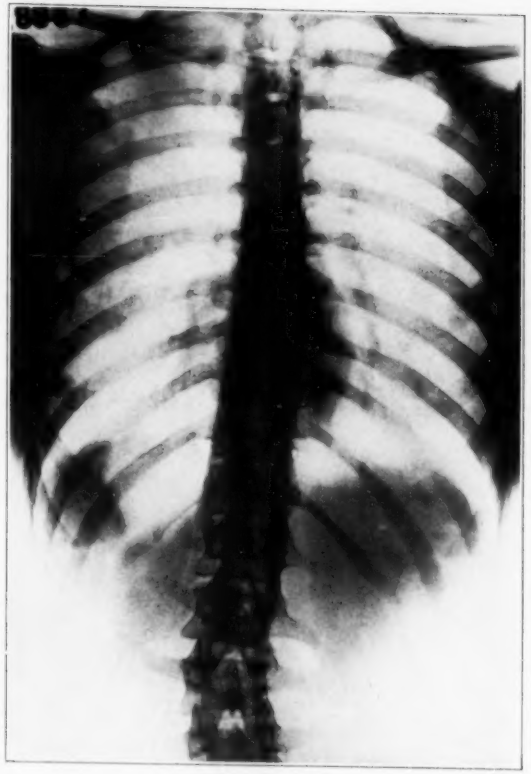

FIG. 25

Case 4. Roentgenogram three years after correction and spine fusion.

TABLE I

RESULTS IN 257 CASES TREATED BY THE WEDGING JACKET

	Mild (25 degrees or less)	Moderate (25 to 50 degrees)	Severe (Over 50 degrees)
Number of cases	14	125	118
Correction by jacket	95 per cent.	69 per cent.	50 per cent.
Correction maintained	80 per cent.	49 per cent.	30 per cent.
Body balance before operation	Good	Fair	Poor
Body balance after operation	Excellent	Excellent	Good
Length of fusion area	8 vertebrae	9 vertebrae	10 vertebrae

loss of correction in the fused area of the spine. Especially in marked curves which have been straightened a good deal, a loss up to 10 degrees may be expected before the new bone is mature. Loss of correction greater than this or any loss localized at one point with widening of the intervetebral space suggests that the fusion is not complete there. In order to detect such changes, an accurate method of measuring the curve, such as that described by Ferguson, should be used. As soon as a pseudarthrosis has been detected, repair should be advised, in order to prevent further loss of correction.

Pseudarthrosis occurred in the fusion area in sixty-one cases or 23 per cent. of the 265 patients treated by the wedging jacket. Of these, forty-seven patients were operated upon again and the defect was repaired. In fourteen cases the diagnosis was made by roentgenographic examination only. Several of these patients declined operation, and the remainder did not require it because there were no symptoms and very little loss of correction. The average loss of correction in patients having a pseudarthrosis was 28 per cent. of the original measurement as compared with a loss of 20 per cent. for all patients. The pseudarthrosis occurred in the thoracolumbar region in thirty-six of the sixty-one cases, indicating that particular care must be taken to produce a strong fusion in this area. In some of the operations we now are reinforcing the mass of chips from the laminae and the spinous processes with small pieces from the tibia.

TABLE II

COMPOSITE ESTIMATE OF RESULTS IN 257 CASES TREATED BY THE WEDGING JACKET

	Mild (25 degrees or less)	Moderate (25 to 50 degrees)	Severe (Over 50 degrees)	Total Percentage
Excellent	9	87	36	51.3
Good	3	23	47	28.4
Fair	2	13	25	15.6
Poor	0	2	10	4.7
Total	14	125	118	100.0

FIG. 26

Case 5. Patient, aged thirteen years, with severe right thoracic scoliosis. Before treatment.

FIG. 27

Case 5. Two years after partial correction and spine fusion. Note improvement in body balance.

During the years 1928 to 1935, inclusive, 301 patients had spine-fusion operations for scoliosis. Fourteen had operations to extend previously fused areas. Twenty-two were operated on after treatment in the old traction jacket or without any attempt at correction. In the remaining 265, the deformity was corrected in a wedging jacket before operation. The causes of the deformity were: poliomyelitis in eighty-six cases; congenital malformations in eleven cases; polio-encephalitis, rickets (possibly), empyema, Friedreich's ataxia, muscular dystrophy, spastic paralysis, and syringomyelia in one case each; and idiopathic or unknown in 197 cases. There were 213 females and eighty-eight males. The ages of the patients varied from two to forty-four years, with an average of thirteen and four-tenths years. There were two deaths ascribable to operation, or an average of 0.66 per cent. Since there was an average of two operations per patient, approximately 600 operations were performed, and the percentage for operations was 0.33. The patients were observed from one to ten years after operation, with an average follow-up period of four and four-tenths years.

For the purpose of estimating the results of treatment, the patients have been divided into groups according to the severity of their deformities. The first group consists of patients with mild curves of 25 degrees or less; the second, of patients with moderately severe curves of from 25 to 50 degrees; and the third, of those with severe curves of more than 50 de-

FIG. 29

Case 5. Roentgenogram of patient standing. Two years after operation. Note improvement in compensation.

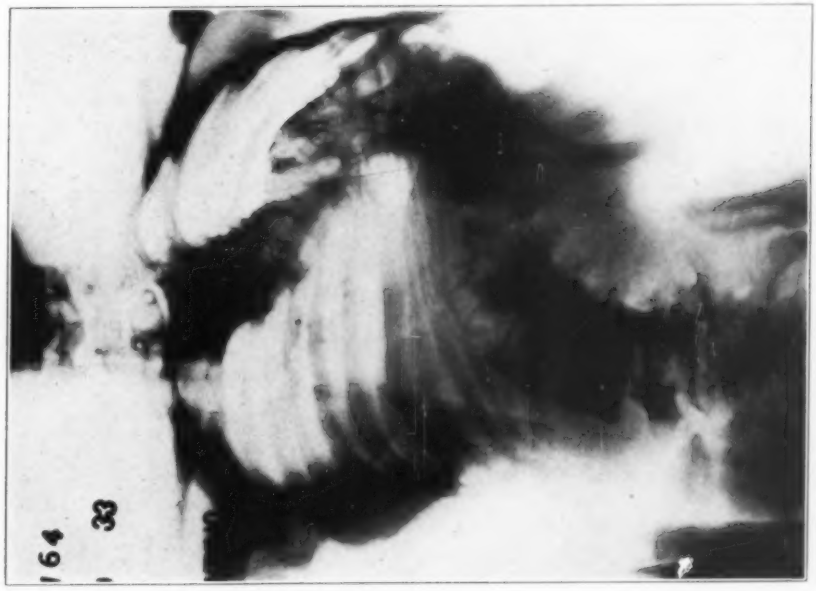

FIG. 28

Case 5. Roentgenogram of patient standing. Before operation.

grees. As will be seen in Table I, by far the greater number were in the second and third groups. As would be expected, the degree of correction was proportionate to the severity of the curve. This has been expressed in percentage of the original deformity rather than in degrees and was 95 per cent. for the mild curves, 69 per cent. for the moderate curves, and 50 per cent. for the severe curves. The correction maintained was 80 per cent. of the original measurement in the mild cases, 49 per cent. in the moderate cases, and 30 per cent. in the severe cases.

As has been pointed out, however, a more important criterion is the improvement in body balance resulting from the treatment. This was changed from an average of good to that of excellent in the mild cases, from fair to excellent in the moderate cases, and from poor to good in the severe cases. It is thus possible to effect a very worth-while improvement in a patient with a curve of 100 degrees with an actual correction to only 80 degrees in the primary curve itself.

Two curves were fused in each of six patients: one had an excellent result; three had good results; and two had fair. Two patients died. The results in the remaining 257 cases are summarized in Table II. In this estimate the degree of correction, body balance, and presence or absence of pain or fatigue were considered. The result was excellent or good in 79.7 per cent., fair in 15.6 per cent., and poor in 4.7 per cent.

SUMMARY

1. From 1928 to 1935, inclusive, 301 patients were operated on for scoliosis at the New York Orthopaedic Dispensary and Hospital. Of these, 265 had had previous correction of the deformity in the wedging jacket.

2. The results of this treatment were excellent or good in 79.7 per cent., fair in 15.6 per cent., and poor in 4.7 per cent.

CONCLUSIONS

1. The wedging jacket is the most effective means yet devised for correcting a lateral curvature of the spine.

2. Spine fusion will maintain practically all of the correction thus obtained.

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CORRECTION OF EXTREME FLEXION CONTRACTURE OF THE KNEE JOINT *

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From the Shriners' Hospitals for Crippled Children

Flexion contracture at one knee joint can be compensated for within certain limits by the equinus position of the foot, by flexion of the opposite knee joint, or by a tilt of the pelvis and change in the lumbar spine. When the flexion is so severe that the foot cannot be made to contact with the walking surface, then ambulation is impossible without some mechanical aid such as crutches, an extension shoe, a brace, or a prosthesis.

The majority of contractures of the knee joint are due to a congenital or a developmental abnormality, tuberculosis or other infections of the knee joint, paralysis of the quadriceps femoris muscle, spastic contractures, injuries or inflammation of muscles, burns of the extremity, fractures into the knee joint, dislocations at the knee joint, and injury to the epiphyseal-cartilage plate.

The contractures may be confined entirely to soft parts and joint capsules or there may be, in addition, a destruction of the articular cartilage with fibrous or osseous union between the tibia and the femur.

The method of correction of the deformity varies with the degree and type of contracture. One may be called upon to utilize several procedures in order to obtain correction of the extreme type. It is usually necessary to lengthen or to sever the contracted tendons as well as the posterior capsule of the joint. If there is a bony ankylosis, a wedge resection or a circular resection is necessary before extension can be started. After the tissues are freed, extension may be obtained in a number of ways,—namely, by simple skin traction, by plaster casts with wedging, by hinged plaster casts with turnbuckles, by skeletal traction, by a plaster spica with skeletal traction, or by mechanical devices to produce gradual extension. In the extreme contractures, a considerable hazard exists because of the possibility of injuring the nerves and the blood vessels in the popliteal space. The nerves and blood vessels may be displaced from their normal positions or embedded in scar tissue, making their identification difficult and increasing the possibility of direct injury. Furthermore, during the correction of the deformity, the vessels may be ruptured or thrombosed, resulting in gangrene; or the nerves may be excessively stretched, causing paralysis. In deformities secondary to infection, there is the possibility of stirring up a latent infection.

One must keep in mind the anatomy of the knee joint and the method of movement of the femur on the tibia. We know that the

* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Los Angeles, California, January 17, 1938.

FIG. 1

Case 1. Flexion contracture of the knee of ten years' duration. Note that the contracture at the knee joint is greater than that at the foot because there is bowing of the tibia at the epiphyseal plate, due to the weight of the foot.

motion at the knee joint does not take place as a simple hinge joint, but that there is a gliding motion of the femur on the tibia. Since the medial condyle of the femur is longer than the lateral condyle, a certain amount of rotation must take place in the tibia during extension. There is also a tendency toward valgus deformity, due to the pull of the biceps and of the prolongation of the tensor fasciae latae on the tibia. In the long-standing contractures without ankylosis, a flattening of the curve of the articular surfaces may be caused by pressure. The menisci will undergo irregular pressure atrophy, and the cruciate ligaments, particularly the posterior, will become contracted. In growing children there is a tendency toward increased growth on the anterior or convex side of the curve, due to a decrease in pressure, and hindrance of growth along the concave side, due to increase in pressure. This abnormal distribution of growth tends toward subluxation and recurrence of the contracture in the growing child.

One of the difficult problems is the prevention of posterior subluxation or the correction of the already existing subluxation during the extension of the contracted knee joint. In order to prevent or to correct luxation, there must be an anterior thrust on the tibia at the same time that the extension force is applied. In the case of the hinged plaster cast, this can be obtained by planing the axis of the hinge anterior to the axis of the knee joint or by providing a sliding joint which allows the lower segment to extend and to go forward. Skeletal traction on the tibia, or on the tibia and the os calcis, with a pull anteriorly to the fixed femur, is a satisfactory method provided there are no contra-indications to the insertion of a pin. Skeletal traction is rarely necessary, and its promiscuous use only adds another possibility of infection.

In this series of four severe contractures of the knee joint, one was of the congenital type, one was secondary to osteomyelitis of the tibia, and two were sequelae to severe burns. The patients were unable to walk without crutches or mechanical aid, and the deformities were unsightly. Correction was instituted in an endeavor to secure a straight, weight-bearing extremity and to conserve the extremity.

CASE REPORTS

CASE 1. D. R., white, female, aged thirteen years and three months, was admitted to the Shriners' Hospital because of a stiff, bent right knee, on October 29, 1930. The

patient gave a history of a fall at the age of three, followed by an infection of the tibia and fibula for which several operations had been performed.

Examination

The knee was ankylosed in a position of from 20 to 25 degrees beyond the right-angle position (Fig. 1). There were scars over the lower end of the femur and along the anterior surface of the leg. It was difficult to measure the extremity, but there was shortening of about four inches distributed equally in the tibia and the femur. The roentgenogram (Fig. 2) shows the bone deformity which is greatest near the knee joint, as the weight of the leg produced a bowing at the epiphyseal plate.

First Operation—November 5, 1930

Lengthening of the hamstrings through a Z incision in the popliteal space was done at this time. Through two incisions on either side of the knee joint, an osteotome was driven in a semicircular manner into the bone in what appeared to be the plane of the joint. It was possible immediately to extend the knee about 40 degrees and, after this had been done, a plaster cast was applied to maintain correction. Good healing took place. Several wedgings of the cast were instituted. Then the Hoke worm-gear knee apparatus was applied, and further correction was obtained to within about 30 degrees of normal. A plaster cast was applied to prevent any recurrence of the deformity and to permit consolidation of the osteotomized bone. An interval was allowed for healing of the incision before the next step of the treatment was begun.

FIG. 2

Case 1. Roentgenogram showing the degree of deformity and the bowing at the epiphyseal plate.

Second Operation—February 25, 1931

Incisions were made on either side of the knee joint and the dissection was carried down to the bone. Beginning at about the tibial tubercle, the osteotome was driven up through the tibia into the femur. The posterior surface of the femur was exposed, after which the osteotomy was completed posteriorly. A wedge-shaped section of bone was removed from the region of the tibial tubercle to allow for correction of the flexion. A pin was driven through the tibia just below the site of the osteotomy, and a double plaster spica was applied, incorporating the good leg. The Hoke traction apparatus was installed, and tension was increased gradually each day until the extremity was practically straight. On May 5, 1931, the plaster was removed and a posterior splint was applied.

Third Operation—November 4, 1931

Lengthening of the femur with two pins in the femur and two pins in the tibia was next carried out. A diagonal type of osteotomy was performed through the knee-joint region. A severe postoperative hemorrhage occurred sixteen days after operation. Later an abscess appeared, with infection of the tibia which necessitated drainage. The lengthening was continued without interruption until about two inches was obtained.

Fourth Operation—August 26, 1933

Because of a persistent discharge, a sequestrectomy was performed.

Last Examination—September 20, 1934

Examination at this time revealed a slight flexion contracture and about two inches of shortening (Figs. 3 and 4). The roentgenographic findings are shown in Figures 5-A and 5-B. During the next six months, there was a slight drainage at intervals, but this subsequently subsided. The patient walks quite well with a small lift on the shoe.

FIG. 3 FIG. 4

Case 1. Patient at completion of the operations.

CASE 2. M. W., white, female, aged thirteen years, was admitted to the Shriners' Hospital on July 24, 1934, because of a deformity of the right leg. At birth, the right leg was smaller than the left and was flexed at the knee and ankle. A photograph, taken at eighteen months of age, showed a flexion contracture of the knee joint of about 90 degrees with the foot in marked equinus. The contracture continued to get worse as the patient grew older and finally the foot almost contacted the buttocks (Fig. 6). She used an artificial limb with weight-bearing at the flexed knee joint.

Examination

The knee was in extreme flexion contracture. The patella was absent. As far as could be determined, there was shorter-

ing of the extremity of about six inches. There was about 15 degrees of motion in flexion. The foot was in marked equinus, and there was a slight flexion contracture of the hip. Motion in the ankle joint was restricted. The calf group and the toe flexors were the only muscles still functioning. The roentgenogram (Fig. 7) shows the extreme flexion at the knee joint, the absence of the patella, and the shortening of the bones.

First Operation—July 30, 1934

A zigzag incision was made on the web between the flexed leg and thigh. Dissection was carried down to the tense fascia which was severed transversely. The semitendinosus and the biceps femoris were lengthened by a Z incision, and the perimysium was cut over the semimembranosus muscle. Flaps of skin were shifted in closing. A plaster cast was applied to the leg two days later, and wedging on the concave side was started. Eight days later adhesive traction was applied. On September 24, 1934, a plaster cast with hinges and a turnbuckle was applied. Examination on October 3, 1934, showed the leg to be extended to the position of 90 degrees of flexion. A new plaster cast with hinges and a turnbuckle was applied to the extremity.

Second Operation—November 5, 1934

An incision was made on the inner side of the knee joint. The semitendinosus and the semimembranosus were severed in Z fashion. The perimysium of the gastrocnemius and a part of the posterior capsule of the knee joint were severed. The biceps femoris was freed near its insertion. Adhesive-plaster skin traction was then applied to the extremity. On November 13, 1934, a plaster-of-Paris cast was applied and wedging

FIG. 5-A FIG. 5-B

Case 1. Roentgenograms taken September 20, 1934, showing end result.

FIG. 6

Case 2. Flexion contracture at the knee joint, beginning at birth. The patient walked with an artificial limb with weight-bearing on the flexed knee.

FIG. 7

Case 2. Roentgenogram showing extreme flexion at the knee joint. The patella is absent.

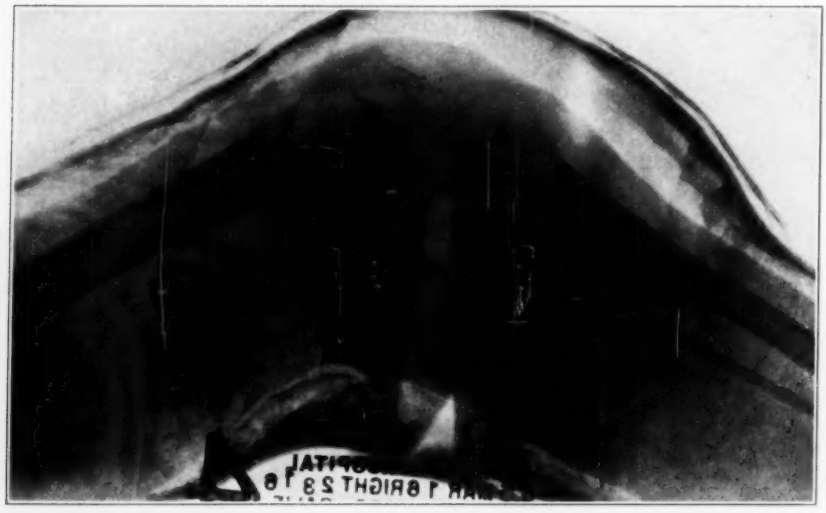

FIG. 8

Case 2. Lateral roentgenogram, showing the extremity in plaster being wedged out to within 45 degrees of full extension. There is no luxation of the tibia.

was started. A month later, a new plaster cast with hinges and a turnbuckle was applied on the anterior surface of the knee, and correction was continued for two months.

Third Operation—March 1, 1935

The scar tissue, which was very thick, was removed from the popliteal region, and all the tendons were lengthened again and the posterior capsule was sectioned. The skin was closed by means of a zigzag incision. A week later a slight sloughing took place in the skin flaps. Several plaster casts with wedging and turnbuckles were applied during the next few months. (See Figure 8.) On July 2, 1935, a plaster cast with a walking iron was put on the extremity which at this time was almost straight.

On August 31, 1935, fourteen months after treatment was begun, the patient was discharged from the Hospital. She was able to walk fairly well. There was some pull on the hamstrings, but there was no power of extension. She put the main part of her weight on the crossbar of the brace, just below the foot.

On February 4, 1936, the patient was readmitted to the Hospital. She walked fairly well with the brace. There was good hip motion, but no power of extension was present at the knee joint. There was some power of knee flexion, and the ankle was in 45 degrees of equinus without motion. Epicritic sensibility was diminished over the lateral surface of the leg, also protopathic sensibility to a lesser degree. An artificial limb was made, but its fitting was difficult, due to the presence of the foot deformity (Fig. 9). Amputation of the foot was not desired. The patient was discharged from the Hospital on May 5, 1936.

FIG. 9

Case 2. Photograph showing the prosthesis. Notice the toes projecting above the artificial foot.

Last Examination—June 17, 1937

One year later there was a little flexion at the knee joint: active flexion, 15 degrees; passive flexion, 30 degrees. The patient had some power of flexion of the toes, of supination of the foot, and of contraction of the gastrocnemius. There was a loss of sensation from above the knee and down the inner side of the leg. The patient walks quite well. If the foot were amputated, it would be easier to fit a prosthesis.

CASE 3. E. J., colored, male, aged nine years, was admitted to the Shriners' Hospital on April 2, 1936, because of contraction of the right knee, following severe burns of the legs at the age of six. At the Berkeley General Hospital, skin grafts had been applied to both legs, but those on the right had not been successful. After leaving the Hospital the patient had received nothing but ultra-violet-ray therapy. The right leg had gradually become contracted at the knee until the heel was opposite the buttocks.

Examination

The patient was able to walk only with crutches. The right leg was in extreme flexion contracture, the calf being symbio-ed to the thigh (Fig. 10). In spite of the long period of about three years of fixed flexion, there were still a few degrees of motion in the knee joint and a definite pull in the quadriceps and hamstring muscles. There were no disturbances in sensation along the lower part of the leg and foot. Some flexion contracture was noted. Motion in the ankle and tarsal joints was normal. There was only a small patch of skin just below the knee joint. Over the knee joint and extending about one-fourth the length of the thigh was a granulating surface which merged into the granulation tissues on the posterior surface of the leg, thus forming a union between the

FIG. 10

Case 3. The calf of the leg is symbiosed to the thigh. Note the ulceration still present three years after the original injury from burns.

FIG. 11

Case 3. Close-up view, showing ulcerations which had been present for three years, but no dressing was required by the patient.

FIG. 12

Case 3. Roentgenogram showing the overgrowth of the femur with luxation of the tibia and the patella.

FIG. 13

Case 3. Roentgenogram, taken March 25, 1938, showing result.

calf and the posterior part of the thigh. There was an extension of the granulating surface on the posterior aspect of the thigh almost up to the buttocks and downward circularly about the leg for about two-thirds of the distance to the ankle joint. (See Figure 11.) It is remarkable that this granulating tissue, which had been present for three years, was dry and glossy without any weeping, and no dressing was used by the patient. Figure 12 shows the contracture, the luxation of the tibia with the overgrowth of femur, and the patella in contact with the articulating surface of the condyle. On account of the long duration of the contracture (about three years) and the presence of granulation tissue, it was realized that any attempt to correct the deformity involved considerable danger of circulatory and nerve disturbance, as well as of infection, with possible loss of the extremity. This was explained to the parents before treatment was instituted.

First Operation—April 8, 1936

This operation consisted in partial release of the contracture and skin grafting. The web between the calf and the thigh was incised, and dissection was carried across this area from both sides. The contracted tendons were lengthened in Z fashion. The tibial nerve with its branches to the gastrocnemius and the small sciatic nerve were exposed during the operation. The popliteal artery pulsated at the base of the wound. It was possible at this time to extend the leg about 40 degrees. The denuded popliteal area was covered with split skin grafts removed from the opposite thigh. A normal saline dressing was put over the grafted area, and a plaster-of-Paris cast was applied from the toes to the groin. The greater part of the grafts remained permanently viable.

Second Operation—April 22, 1936

A considerable part of the remaining granulating area was covered with split skin grafts and Thiersch grafts which were removed from the abdomen.

Third Operation—May 15, 1936

The remaining portion of the granulating surface was covered with split skin grafts. After healing had taken place, a modified Russell type of traction was applied to the extremity, and the patient was placed on a Whitman frame to correct the flexion contracture of the hip. One of the main problems was to correct the existing posterior luxation at the knee joint. Various types of plaster casts with hinges and turnbuckles were applied. On one type, an adjustable hinge to allow traction in extension was utilized and, in addition, a turnbuckle was placed anteriorly to pull the leg forward to help correct the luxation of the tibia. After completion of this procedure, correction was obtained to within 15 degrees of full extension of the knee joint. (See Figures 14 and 15.) Because of the fact that healing had been delayed for three years, skeletal traction was not utilized, as it was thought there was too great a chance of infection of the tibia. It was impossible to correct the subluxation, so there was a marked prominence of the lower end of the femur and patella at the completion of

FIG. 14 FIG. 15

Case 3. Lateral and anterior views of patient on discharge.

FIG. 16

Case 4. Patient nine months after burn on the right extremity, showing circular ulceration about the knee with the upper calf united to the lower thigh. Notice the marked flexion contracture of the hip and the heavy scar bands across the groin.

FIG. 17

Case 4. Roentgenogram showing the marked flexion with subluxation of the tibia on the femur. The patella is pulled down on the condyle.

the correction of the deformity. The patient could flex the knee about 10 degrees, and about 5 degrees more motion could be obtained passively. He was dismissed wearing a long leg brace for protection. Subsequent follow-up examinations in clinics showed occasional ulceration, but, in general, the condition remained about the same. Further treatment was instituted on March 23, 1938, to complete the correction and to obtain more motion (Fig. 13).

CASE 4. R. W., white, male, aged five years, was admitted to the Shriners' Hospital, October 22, 1936, because of contractures of the right hip and knee, following severe burns on both legs and abdomen received in December 1935. He had been taken to a local county hospital and, at the end of three weeks the physician reported there was no chance for his recovery. He was, therefore, taken home where he subsequently recovered, but severe contractures of the knee and hip joints developed. The boy received no treatment until he was brought to the Shriners' Hospital about nine months later.

Examination

The patient had a marked flexion contracture at the right knee joint of about 160 degrees. The upper part of the calf was joined to the lower part of the thigh. There was a complete circular ulcer extending around the leg and thigh. Some normal skin was present over the anterior part of the knee and lower thigh. The hip was in about 90 degrees of flexion contracture with heavy, scar-contracting webs extending from the abdomen to the thigh (Fig. 16). There was some evidence of nerve involvement as shown by the very weak hamstring and the tibialis anterior muscles; most of the muscles were below normal strength.

The roentgenogram (Fig. 17) shows the contracture at the knee joint, disuse atrophy of the bones, and the relative position of the femur and the tibia.

FIG. 18

Case 4. Roentgenogram showing almost full extension at the knee joint. There is some posterior luxation of the tibia.

FIG. 19

FIG. 20

Case 4. Lateral and anterior views showing the correction obtained. The flexion contracture of the hip has also been corrected by operation.

First Operation—October 28, 1936

An incision was made between the juncture of the granulating area of the calf with the posterior surface of the thigh. All of the hamstrings were lengthened by a Z incision. The dissection was then carried down to the popliteal space. The peroneus communis nerve, which was exposed, was later surrounded with a fat graft. At the end of the operation the denuded area in the popliteal space was covered by split skin grafts removed from the left thigh, and a considerable portion of the remaining ulcerated areas was treated with Thiersch grafts. The leg was brought out almost to the position of 90 degrees of flexion.

Second Operation—February 12, 1937

The heavy, dense scar in the inguinal region was excised, after which a series of flaps of skin in zigzag form were shifted to fill in part of the gap. A considerable defect on the inner side of the thigh was filled in by a full-thickness graft removed from the lateral abdominal region. Gauze was wet with saline solution, and with sea-sponge pressure was put on the operated area, and a plaster spica was applied to keep the extremity at rest. Subsequent treatment consisted of plaster casts to correct the foot flexion and remaining knee flexion. The patient was kept on a Whitman frame to stretch the flexion contracture at the hip. He was discharged from the Hospital with a long caliper brace on May 24, 1937, about seven months from the time of admission.

Last Examination—August 12, 1937

Examination at this time showed full correction of the knee contracture with slight subluxation of the tibia (Fig. 18) and a small amount of contracture at the hip joint (Figs. 19 and 20). There was still considerable weakness of the muscles of the foot. Some lengthening of the right tibia was noted. The patient was able to flex the knee 90 degrees, with fairly good power of extension from that position.

CONCLUSIONS

Extreme flexion contracture of the knee joint is a very disabling deformity, but it is amenable to operative correction. Care must be taken not to injure the nerves and blood vessels either by operation, by too rapid correction, or by rough manipulative methods. Skeletal traction is a useful adjunct, but its promiscuous use is to be deplored, especially when there is the possibility of infection.

SCIATIC PAIN OF UNKNOWN ORIGIN

An Effective Method of Treatment *

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Sciatic pain may be classified as of unknown origin when, after an exhaustive clinical study, no cause can be found. A general medical examination, including comprehensive laboratory studies, is the initial step to rule out such systemic causes as diabetes, perineuritis from metallic poisoning, and pain due to intrapelvic or intra-abdominal pathology. Thereafter orthopaedic and neurosurgical consultations, together with lumbar puncture and manometric readings, follow. Possible foci of infection are carefully investigated. The examination is concluded by roentgenograms of the lower spine and the pelvis, which comprise true anteroposterior, lateral, and 45-degree-angle views; and in this group these are supplemented by additional lateral views of the lumbosacral spine in the position of maximum flexion and extension. If these various studies fail to determine the etiology, then the sciatic pain is classified as of unknown origin.

It is the purpose of this paper to present a method of treatment for sciatic pain, which has been successfully employed where the etiology of the sciatica is not known. The method is also applicable for immediate relief of severe sciatic pain while a clinical study is being made to determine the cause. This report is based upon the results obtained in a group of seventy-five patients with sciatica of unknown origin, who were seen in the four-year period ending January 1, 1937, and who represent 5 per cent. of all patients examined in this interval, with sciatic pain as a predominant complaint. In the complex therapeutic problems presented by the sciatic syndrome, it is well recognized that no single method of treatment will at all times suffice. It is also true that in a certain number of patients (in this group, 50 per cent.) symptoms or signs later develop, which make it possible to allocate the source of their complaint to one or more etiological factors. However, in those individuals in whom no cause for the sciatic pain is found, or in whom the etiology is not clear at the time of the first and immediately subsequent examinations, it is none the less desirable to attempt relief of pain which is often severe. With the therapy here described we have had greater success than with any other method.

In the type of case under discussion, as well as in cases of sciatica which accompany demonstrable disorders of the lower back, the exact

* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 4, 1938.

origin of the pain is not clearly understood because of the lack of pathological information. A true neuritis of the sciatic nerve is not considered here, as in none of these individuals did neurological examination show evidence of such pathology.

That sciatic pain is in part a referred pain has long been recognized, and a typical example is the case in which the symptoms result from pressure over the posterior sacro-iliac ligament (Fig. 1) which causes pain to be referred down the posterior mid-thigh, and in particular to the lateral aspect of the lower leg. From an analysis of the findings in a large series of patients, Badgley concluded that low-back pain with radiation of pain into the leg is a clinical syndrome, arising from a primary lesion located in the lumbar, lumbosacral, or sacro-iliac regions, and is of muscle, joint, or skeletal origin. He further stated that the pain is due to irritation of sensory-nerve endings in this area, and is radiated primarily by a reflex mechanism which is typically postaxial in distribution.

From another angle, Steindler has well demonstrated this reflex character of sciatic pain in his description of the posterior syndrome, by which he refers to the structures supplied through the posterior division of the spinal nerve. Following this author's suggestions, the writer has likewise been able to exhibit localized areas of tenderness or "trigger points" in cases of posterior musculo-aponeurotic or ligamentous involvement. These tender points are the source of afferent impulses which initiate the reflex discharge of pain. The leg signs—that is, sciatica—were especially well shown in lesions of the deeper ligamentous structures of the lumbosacral junction, of the iliolumbar ligaments, and in cases of sacralization. We have found local injections of novocain of value not only as an aid in diagnostic differentiation as to the source of the symptoms, but also as a therapeutic measure. Kellgren similarly reported satisfactory therapeutic results from local injections of novocain into these tender points. Alcohol injections of these same painful areas, as suggested by Harris, have not been attempted.

An acceptable anatomical basis for the presence of referred pain in patients with pathological conditions of the intervertebral articulations is presented also by Steindler, when he calls attention to the nervus sinuvertebralis described by Purkinje in 1845 and by von Luschka in 1850. This nerve, arising just outside the intervertebral foramina, turns back into the intervertebral canal and the nerve endings go to the pedicles, the interiors of the bodies, the loose areolar perimeningeal tissue, and the periosteum.

It is accepted that pathological change in or about the intervertebral foramina is a cause for low-back pain and sciatica. The more common factors which precipitate such symptoms are: arthritis of the spine, unstable facets of the vertebrae, and obvious structural change as seen in cases of spondylolisthesis.

It is also believed that disease of the sacro-iliac joint is a cause of sciatica, and that this sciatic pain is most satisfactorily explained as being

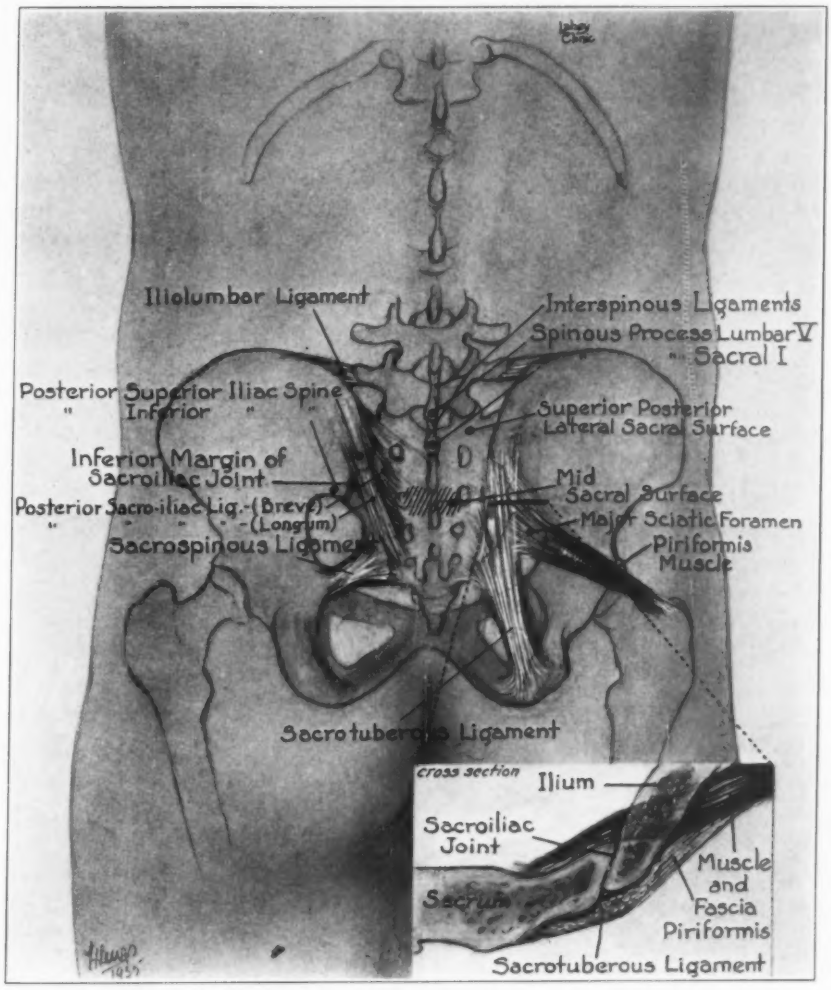

FIG. 1

Illustrating anatomical landmarks in the low-back region with particular reference to the areas palpated for tenderness during clinical examination. The insert depicts the close relationship of the piriformis muscle to the sacro-iliac joint; the latter is enclosed by the muscle and its fascia.

due to spasm and probable congestion of the piriformis muscle (Fig. 1), as described by Freiberg. Although operative division of the tendon of the piriformis muscle has not been done, in eight patients with demonstrable clinical and roentgenographic evidence of sacro-iliac disease with sciatica, novocain injections of the substance of the piriformis muscle and of its fascia have been carried out with marked relief of the sciatic pain. These patients did not respond to purely conservative measures, and all had refused any operative therapy other than the injection.

It is, therefore, believed that sciatica associated with musculoskeletal disorders in the low back is the result of pathological change either in or

about the spine and the intervertebral foramina, or of disease of the sacroiliac joint with its accompanying spasm of the piriformis muscle, or, finally, of myofascitis. The fact that in the present group of cases no definite etiology was originally demonstrated does not rule out the probability of such a causal relationship. As is well known, a patient may have definite sciatica with or without back symptoms, yet the initial examination will not disclose the etiology. In thirty-eight cases of this group it was possible later to demonstrate the cause of the sciatic pain.

Another point of interest in the study of sciatica is that the distribution of pain in the lower extremities is not indicative of the source of pain. This is particularly well borne out by our experience with herniation of the intervertebral discs. In twenty-five such cases proved at operation, the findings repeatedly showed that the distribution of the pain in the lower extremities did not correspond to the nerve root or roots irritated by the herniation. This point is further emphasized by Badgley in a study of 447 patients with low-back pain and sciatica, wherein he stated that the type of skeletal change seen in the roentgenograms bore no definite relationship to the extent and location of radiation of pain, nor was local tenderness more evident over the site of the most marked skeletal changes. It may be, as Kimberley suggests, that irritation of the nerve root lowers its threshold to stimuli, and protopathic sensations are sent out along its motor branches, while the sensory branches within the nerve are also stimulated. If the stimuli are strong enough, they may spill over into other branches of the sciatic nerve, resulting in a wide distribution of the pain in the lower extremities.

In the treatment of patients with sciatica, it has been our policy to mobilize them as rapidly as possible and, consequently, the general line of treatment has been directed toward mobilization, as opposed to immobilization. Many authors have reported excellent results with the use of plaster casts and long rest in bed, but in our hands, with the exception of cases of degenerative arthritis of the spine, the results from this treatment have not been encouraging. It is true that the sciatica is often relieved, but then the patients experience a relatively prolonged period of disability before again returning to a reasonably normal status, due to pronounced stiffness and muscle atrophy. Another method of therapy which has enjoyed wide vogue is that of saline or preferably novocain-saline injection into the epidural space by way of the sacrococcygeal foramen, originally described by Sicard in 1901. In our hands this procedure has been disappointing and has consequently been abandoned.

The method of treatment employed in this group of patients is a combination of two, and in some instances of three, procedures: (1) perineural injection of the sciatic nerve with novocain (1-per-cent. solution); (2) traction to the affected extremity; and (3) in an increasing number of cases manipulation of the low back under intravenous pentothal anaesthesia. Traction for the relief of sciatica has been utilized by many men, but it was the author's impression that perineural injection of the

sciatic nerve had not been so commonly employed. In a recent study of the literature, however, he finds that Wilfred Harris of London reported intramedullary saline injections of the sciatic nerve in 1926. The difference between the two techniques is essentially that in the method used by Harris the actual substance of the sciatic nerve is injected under a moderate amount of pressure, while in the procedure here described, the objective has been to surround the sciatic nerve with the solution and possibly also to inject its sheath. In addition, the fascia and substance of the piriformis muscle, and in some instances the posterior sacro-iliac ligament, are thoroughly infiltrated.

In more recently treated patients, traction to the extremity has been omitted in all but the most resistant cases. It has been found that by a combination of perineural injection and manipulation the sciatic symptoms have been in a large measure controlled, and, consequently, it has been possible to mobilize the patient more rapidly. As will be described later, the manipulations are in no sense drastic, and it is believed that, with the type of manoeuvers carried out, no injury is done to the ligamentous, muscular, or bony structures of the trunk and the pelvis.

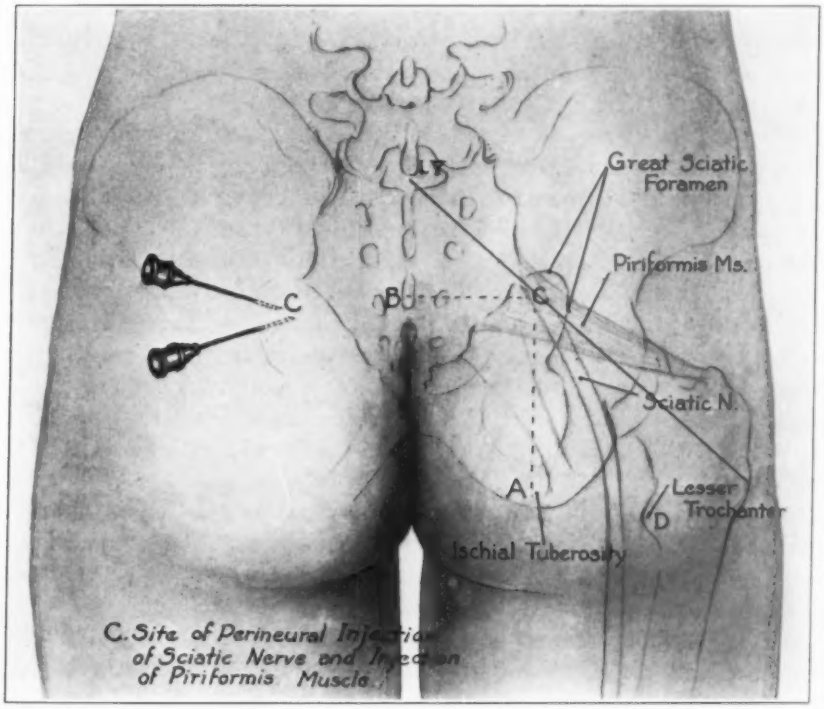
Great Sciatic Foramen
Piriformis Ms.
Sciatic N.
Lesser Trochanter
Ischial Tuberosity
C. Site of Perineural Injection of Sciatic Nerve and Injection of Piriformis Muscle.

FIG. 2

Technique of perineural injection of the sciatic nerve as it emerges through the greater sciatic foramen. The intersection of the dotted lines and the line drawn from the femoral trochanter to the fifth lumbar spinous process indicates the point at which the needles are introduced.

A solution of 1-per-cent. novocain is now employed rather than a combination of novocain and saline. This regime has been adopted because use of the novocain solution alone has been definitely more efficacious in relieving immediate discomfort and in maintaining freedom from symptoms than has the combination of novocain and saline. The explanation of this is not understood.

The objective of the injection procedure is to reach the perineural area of the sciatic nerve as it emerges from the pelvis through the greater sciatic foramen, as well as to inject the adjacent fascia and substance of the piriformis muscle. The patient is placed in the supine position on the operating table which is so adjusted that the hip joints are flexed approximately 20 degrees. With the buttock of the affected side exposed, the points of insertion of the needle are determined by the intersection of a line projected from three inches (in the male) to three and one-half inches (in the female) directly laterally from, and at the level of, the apex of the intergluteal fold, and an imaginary perpendicular line erected from the ischial tuberosity (Fig. 2). This point is marked on the skin by a small dot of gentian-violet stain. The point of injection is further checked by drawing another imaginary line from the mid-lateral aspect of the greater trochanter to the spinous process of the fifth lumbar vertebra. This line indicates the extreme lateral margin of the injection field. In the average pelvis, this line will intersect the two lines already mentioned at essentially the same point.

The entire field is then prepared with iodine in the usual manner. The skin is anaesthetized over the area identified by the dye, and a 20-gage 6-inch needle is passed in an anteromedial direction from this point at an angle of 45 degrees with the skin surface. Little or no discomfort is experienced until the fascia underlying the mass of the gluteus maximus muscle is encountered. A further injection of novocain may then be necessary. If the needle is in the correct position, as it progresses inward, the patient will shortly experience a transitory lightning-like pain, extending down the posterior mid-line of the lower extremity and corresponding to the general course of the sciatic nerve. This is proof that the needle is in the correct location, and it is then withdrawn about five-tenths of a centimeter. With this needle as the center of a small circle, two other needles are similarly passed inward and downward until the fascia and substance of the piriformis muscle are encountered, which may be recognized by the degree of resistance offered in comparison to that encountered as the needle traverses the mass of the gluteal muscle. It will be noted that all of these needles enter the greater sciatic foramen.

A solution of 1-per-cent. novocain with two drops of 1/1000 adrenalin to the ounce is employed, and an average amount of fifty cubic centimeters is placed immediately about the trunk of the sciatic nerve. Into the remaining two needles an additional total of 100 cubic centimeters of the solution is introduced.

In an occasional instance, the patient may be susceptible to novocain

and, therefore, may have a mild reaction, as exemplified by a rapid pulse, increased rapidity of respiration, and a sensation of faintness. The precaution is always taken to ask the patient if untoward symptoms have been experienced with the previous use of novocain,—for example, in the extraction of a tooth, or in a tonsil operation. If there is any reason to suspect sensitization, ten to fifteen cubic centimeters of the solution of 1-per-cent. novocain is slowly introduced about the nerve, and the remaining injection is carried out with normal saline solution. Although they gave no history of sensitivity to novocain, ten patients were so treated, to determine if the novocain-saline injection was as effective as the novocain solution. In none of these cases were the results as satisfactory as they were after a second injection of novocain. In consequence, we now routinely use the solution of 1-per-cent. novocain.

Following this procedure, if the needles are correctly placed, the sciatic pain will be diminished or absent. If no relief is obtained, the needles have not been correctly placed, and they should be withdrawn and again introduced.

When this operation is completed, the patient is returned to bed, and skin traction is applied to the extremity if the sciatica is of long duration. The Russell method of skin traction has proved to be most satisfactory. Application of adhesive to the entire extremity—that is, from the upper thigh down to just above the ankle—is reserved for those patients who are of the wiry, very muscular type. It is more effective to apply initial maximal traction than it is to apply a small amount and then progressively to increase the weight,—the same principle that has been repeatedly demonstrated in the use of traction in the reduction of fractures of the lower extremity. In the average case, for the first thirty-six hours, an initial pull of from twenty-five to fifty pounds is applied; it is then reduced to a maintenance traction of from ten to fifteen pounds. When employed, the average duration of the traction was two weeks; the maximum, six weeks; and the shortest, five days.

Manipulation procedures were added to our armamentarium with considerable caution some seven years ago. They were first applied to patients with acute low-back pain, with or without sciatica—particularly those with a diagnosis of unstable fifth lumbar vertebra—and to some individuals with what was taken to be acute sacro-iliac sprain. Like many physicians, the writer could not satisfactorily explain the experience of patients with acute low-back symptoms, who, discouraged by their slow progress under accepted orthopaedic measures, went elsewhere for office manipulative therapy, with relatively immediate relief. A study of these methods resulted in a selection of torsion manoeuvers applied to the trunk and pelvis as the most effective and, at the same time, the least traumatic to the patient. In this connection, the author is indebted to the textbook by Bankart. Manipulation of the back is always performed under general anaesthesia, preferably obtained by intravenous injection of pentothal. This anaesthetic gives excellent relaxation for short periods

of time, has relatively little after-effects, and is ideal for this particular purpose.

In particularly stubborn cases of sciatica, Baer's manoeuver—hyperflexion of the hip, with the knee extended—has also been utilized. It is done cautiously, however, and in graduated stages. No attempt is made to have the foot touch the occiput.

In the past two years, manipulative therapy has been added as a part of the treatment in an increasing number of these patients with idiopathic sciatica. As a result, there has been progressively less frequent use of traction, and, in addition, a shorter period of hospitalization.

Following the injection and manipulation, and with or without traction, all patients are instructed in muscle exercise particularly designed to develop the low-back muscles and those of the gluteal group. When the patients become ambulatory, posture training is also given as indicated. Intensive heat and massage are likewise utilized, chiefly applied to the low back, the region of the buttocks, and the upper part of the thigh. We have found hot fomentations and infra-red light the most effective forms of heat.

The results obtained by this method of treatment have been most encouraging. To record these results and yet to avoid confusion because of the many variable factors involved, the patients have been arbitrarily divided into three groups according to the initial therapeutic procedure employed. All of these individuals were given physiotherapy and muscle exercises as described. The duration of the average follow-up period was two years; the shortest, one year; the longest, four years. Of the entire seventy-five patients, all except ten obtained immediate relief of pain. Thirteen were benefited temporarily from three to six months. Ten patients were symptom-free for one year and then did not return or answer follow-up letters. Finally, it will be remembered that in thirty-eight cases it was eventually possible to make a definite diagnosis and so determine the cause of the sciatica and advise appropriate treatment.

Group I

In the fifteen cases which comprise this group, the sciatica, although sufficiently severe to necessitate medical care, was not as disabling or of as long duration as that present in the other two groups.

Perineural injection of the sciatic nerve with a solution of 1-per-cent. novocain was the method of treatment. Immediate relief was obtained in all, and eleven patients continued to be free from sciatic pain for an average period of twenty months. In four cases, the injection was repeated from two to three times at varying intervals (two to eight months) after the first treatment, but in none were subsequent symptoms as severe as those experienced when the patient first came to the Clinic.

Group II

Twenty-seven patients were treated by perineural injection, followed

by traction applied to the lower extremity. Sixteen of this group had no recurrence of sciatic pain after one year, while twelve were symptom-free after two years. Of the remaining patients, seven received temporary relief (from three to six months); four were not benefited.

Group III

Thirty-three patients were submitted to perineural injection followed by low-back manipulation under general anaesthesia. In nineteen cases there was no recurrence of sciatica. Three patients were free from pain for from twelve to eighteen months; five were relieved for from three to six months; and six received no aid from this treatment.

SUMMARY

This effective method of treatment for the relief of sciatic pain is applicable in those cases in which the etiology of the sciatica is not known, and it is also employed for immediate relief of sciatic pain while a clinical study is being made to determine the cause.

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THE SCALENUS ANTERIOR MUSCLE IN RELATION TO SHOULDER AND ARM PAIN *

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The rôle played by the scalenus anterior muscle in certain nervous and vascular disturbances of the shoulder and arm was suggested by J. B. Murphy in 1906. The actual part played by this muscle in the complications arising in the presence of a cervical rib was not clearly understood until 1927, when Adson and Coffey pointed out that sectioning of this muscle would relieve the symptoms associated with cervical ribs. In fact, since their able and thorough explanation of this symptom complex, the more tedious and hazardous resection of the cervical rib is rarely done. There are in the literature numerous reports of isolated cases and small series of cases, manifesting symptoms of brachial-plexus and subclavian-artery compression attributed to highly situated first ribs. Brickner and Milch, in 1925, as well as others, advised partial resection of the first rib, and obtained satisfactory results.

Three years ago, Ochsner, Gage, and DeBakey reported a series of six cases presenting the clinical picture of cervical rib, but in which no cervical rib could be demonstrated. These authors termed this condition "scalenus anticus (Naffziger) syndrome". In this most excellent contribution, a clinical picture, previously unidentified, was fully and adequately portrayed. Ochsner and his associates described the syndrome as characterized by pain referred to the shoulder, to the supraclavicular area, down the arm to the ulnar and flexor surfaces of the forearm to the hand, and frequently to the side of the neck and the ear. The author has noted rather frequently that pain is also present in an area between the spine and the mesial border of the scapula. The symptoms varied from an uncomfortable tingling or numb sensation to severe lancinating pain. Pressure over the scalenus anterior muscle produced ulnar pain. Likewise, if the head was turned toward the affected side with the neck extended, on deep inspiration or depression of the shoulder the pain was increased. Associated with this syndrome, or as a part of it, were vascular manifestations, consisting of diminution of pulse volume on the affected side, decreased skin-surface temperature, numbness, coldness, and formication of the arm. These vascular changes could be proved by oscillometric tests. Todd, in 1912, ascribed an abnormal compression of the subclavian structures to an abnormal development of the shoulder girdle. He stated that when either the sternal end of the shoulder girdle presented an arrested descent or the acromioclavicular descent was in-

* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 3, 1938.

creased symptoms might develop. As the shoulder descent was greater in women, compression symptoms of the subclavian structures developed in them more frequently. Ochsner accepted this anatomical or developmental anomaly as the soil for the scalenus anterior syndrome: "The fact that symptoms are not, as a rule, manifest until adulthood suggests an additional exciting factor. This we believe is contraction and spasm of the scalenus anticus muscle, which results from irritation and stimulation of the brachial plexus, some of the fibers of which supply the scaleni muscles. This produces an abnormal elevation of the first dorsal rib which in turn causes greater irritation and stimulation of the brachial plexus, establishing a vicious circle. . . . This compression [brachial plexus and subclavian artery between the scalenus anterior muscle and the first rib] may be due to stretching of these structures by an abnormally low position of the shoulder, to high fixation of the sternum and ribs (Todd), to low origin of the brachial plexus (Jones), and to spasm of the scaleni muscles, resulting from brachial plexus irritation. Undoubtedly, many if not all of these factors are responsible in the majority of instances." Ochsner sectioned the scalenus anterior muscle through its tendinous area just above its insertion into the first rib, with almost spectacular relief of symptoms. Ochsner's differential diagnosis of scalenus anterior syndrome considered cervical rib, subacromial bursitis, supraspinatus-tendon rupture, cervicothoracic sympathalgia, Raynaud's disease, and brachial neuritis. "The clinical picture in subacromial bursitis and supraspinatus tendon rupture simulates that of scalenus anticus syndrome in that the pain in both is apt to be referred to the shoulder. In the former, however, tenderness is limited over the supraspinatus tendon and subacromial bursa without other accompanying nervous and vascular manifestations."

Unquestionably, the so-called scalenus anterior syndrome exists as a not uncommon condition, and, when uncomplicated by other lesions about the shoulder joint or the cervical spine, it is cured by a tenotomy of this muscle. During the past three years many cases have been recognized and subjected to surgery, with relief of symptoms (Craig and Knepper; and Henschen and Heusser). Spurling and Bradford have reported a series of twenty-one cases, and, to the writer's knowledge, many other surgeons have had similar success following the recognition and treatment of this condition.

However, the clinical picture of scalenus anterior syndrome may be much more complicated and have far more intimate associations with other lesions than has been suggested by Ochsner and his associates. In fact, it has been the experience of the author to find the scalenus anterior syndrome a sequela of primary lesions of the shoulder joint and cervical spine much more frequently than as an isolated clinical entity. So often is this the case that orthopaedic surgeons should be doubly indebted to Ochsner and Naffziger for bringing this syndrome to their attention.

Untold numbers of cases of so-called brachial neuritis, associated

with such lesions as arthritis and periarthritis of the shoulder, cervical arthritis, bursitis of the subacromial bursa, and partial rupture of the supraspinatus tendon, have been encountered and described. The clinical picture of such a common condition as calcification of the supraspinatus tendon is not infrequently complicated by pain, paraesthesia, and numbness and swelling of the lower arm and hand. On what anatomical basis can an isolated lesion about the superior surface of the shoulder capsule account for pain in the forearm and hand? Likewise, on what anatomical basis can the true picture of pain and weakness of the arm and diminished skin temperature be associated with infectious and traumatic lesions of the cervical spine? Why do these complications disappear following local therapy to these lesions of the cervical spine and the shoulder?

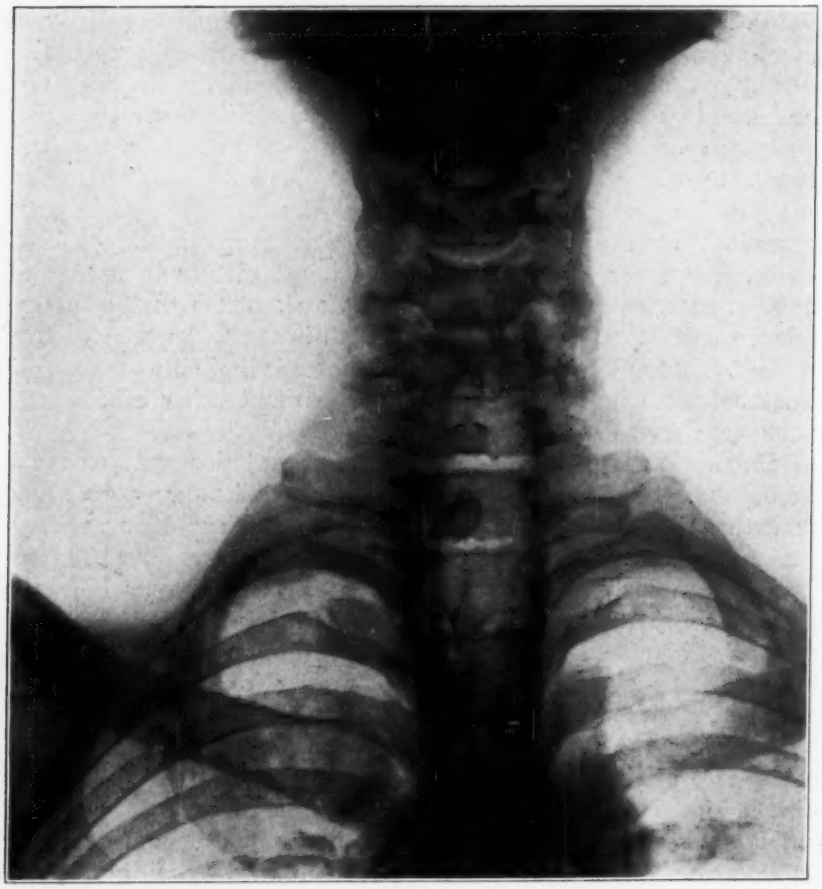

FIG. 1

Roentgenogram of patient with bilateral scalenus anterior syndrome, illustrating anatomical type with abnormal shoulder descent and long neck. The first costosternal unction is superimposed over the fifth thoracic vertebra. The patient was relieved by postural instruction.

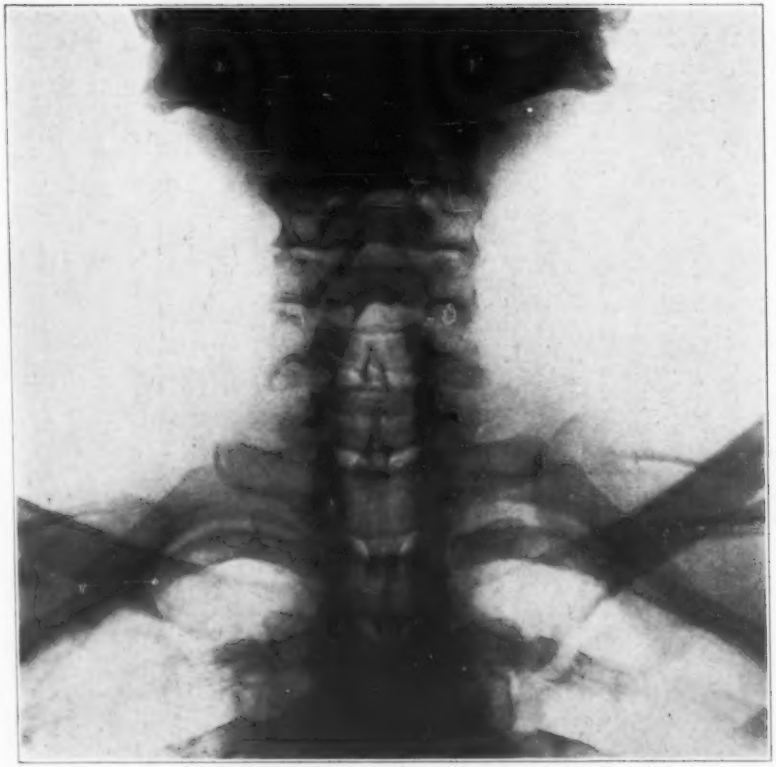

FIG. 2-A

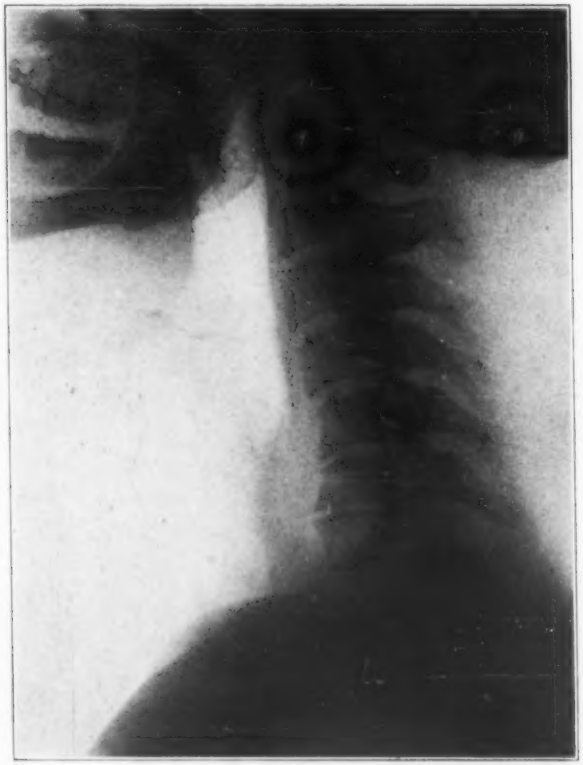

FIG. 2-B

Anteroposterior and lateral roentgenograms of a patient who had an old traumatic arthritis of the fifth, sixth, and seventh cervical vertebrae with an associated scalenus anterior syndrome on the right side and extensive weakness of the muscles of the upper arm and shoulder. The patient was cured by a scaleniotomy. Compare this normal relationship of rib and shoulder girdle with Fig. 1.

A patient with abnormal descent of the shoulder girdle, characterized by sloping shoulders and an apparently long neck, is the anatomical type in which a scalenus anterior syndrome is more likely to develop. In roentgenograms of the base of the neck, taken in the anteroposterior plane with the tube centered over the first thoracic vertebra, ordinarily the first costosternal junction will be superimposed over the third thoracic vertebra. In this anatomical variant, as illustrated in Figure 1, the first costosternal junction is seen superimposed over the fifth thoracic vertebra. This anatomical configuration may be associated with faulty posture and a consequent backward position of the shoulders, a predisposing factor to scalenus anterior syndrome. As Todd stated, the shoulder girdle descends farther in women than in men. Therefore, it is to be expected that the scalenus anterior syndrome will be more frequently encountered in women. Although abnormal descent of the shoulder girdle is a predisposing factor, numerous cases of scalenus anterior syndrome have been encountered in individuals who do not present this anatomical variation. (See Figures 2-A and 2-B.)

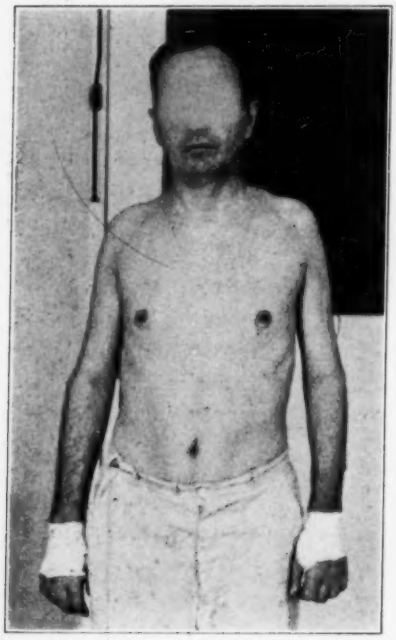

FIG. 3-A

Photograph of a patient who had an inadequately immobilized fracture of the left clavicle, which eventually united with angulation. Because of constant pain during treatment of the fracture, the shoulders were held voluntarily depressed and immobile. Marked signs of bilateral scalenus anterior syndrome developed, which persisted and incapacitated the patient for five months. The patient was relieved by bilateral arm traction (Fig. 3-B).

The scalenus anterior muscle arises from the transverse processes of the third, fourth, fifth, and sixth cervical vertebrae. The muscle extends downward and slightly forward to insert into the anterior third of the first rib at the scalene tubercle. When the cervical spine is fixed, the muscle elevates the first rib. When the first rib is fixed, the joint action of the two anterior scaleni flexes the cervical spine. The subclavian artery arches laterally between the scalenus anterior muscle and the first rib. Likewise, emerging from the cervical vertebrae and extending downward and laterally, the third, fourth, fifth, sixth, seventh, and eighth cervical nerves pass from behind the scalenus anterior muscle to form the cervical and brachial plexuses. As the sixth, seventh, and eighth cervical nerves lie in close approximation to the subclavian artery and the scalenus anterior muscles, these nerves, or the areas supplied by them, are more frequently involved in lesions of the scaleni. In other words, the ulnar nerve, arising from the eighth cervical

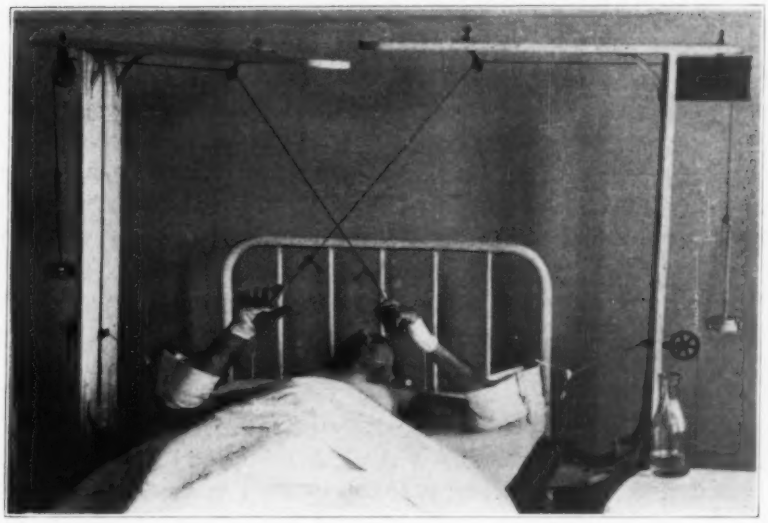

FIG. 3-B

Same patient as in Fig. 3-A shown in simple balanced forearm traction which relieved the signs and symptoms of bilateral scalenus anterior syndrome.

root, is most frequently affected, although the cutaneous nerve of the neck and the occiput and the nerve to the trapezius muscle, arising from the third cervical root, are not infrequently involved.

Spasm of the scalenus anterior muscle, or spasm of the muscle associated with hypertrophy or eventual contracture, may result in a variable degree of damage to the cervical roots lying behind the muscle. This lesion of the roots may manifest itself as a simple nerve irritation with cutaneous or muscle pain in the areas supplied by the involved roots, or, if the lesion is of long standing, actual muscle weakness and paralysis may occur. These symptoms and signs, similar to those associated with cervical or supernumerary ribs, have been found in numerous cases. The vascular symptoms consist of a sensation of coldness, usually in the hand, and recurring or persisting swelling and patchy areas of subjective numbness, often without actual disturbance of sensation. Probably the most common complaint by the patient is that of a dull ache in the hand and the forearm, associated with a feeling of continual pressure as if something were squeezing the extremity from without. The areas of subjective pain, as has been stated, may be referred to any or to all of the skin areas supplied by the third, fourth, fifth, sixth, seventh, and eighth cervical roots. Weakness of the deltoid, of the biceps, of the triceps, and of the flexor muscles of the hand is most easily identified in a cursory examination. There is, however, no exact pattern of muscle lesions found in all of these cases.

For this discussion, the scalenus anterior syndrome associated with the anatomical skeletal variation is of least concern. Having mentioned

the *modus operandi* of this syndrome, it is seen readily that under certain circumstances any lesion, traumatic or infectious, involving the cervical spine or the shoulder girdle, may be the initiating factor in causing a scalenus anterior syndrome. The innervation of the scalenus anterior muscle is derived from the seventh cervical root, one of the three roots most frequently involved. This is the explanation of the vicious circle described by Ochsner.

Lesions of the cervical spine from the third vertebra downward may initiate the syndrome by direct irritation of the scalenus anterior muscle, as it arises from these vertebrae. On the other hand, lesions of the shoulder girdle, such as a fractured clavicle (Fig. 3-A), or a painful shoulder associated with calcification of the supraspinatus tendon * may initiate the syndrome by a concomitant diffuse muscle spasm accompanying the lesion. Voluntary splinting of the affected arm with depression of the shoulder, as seen frequently, may be another factor in initiating the scalenus anterior syndrome. Any lesion with recurrent symptoms, or characterized by variable periods of exacerbation and remission as are many shoulder lesions, may be accompanied by recurrent or evanescent signs of the scalenus anterior syndrome. If the foregoing statements are true, it might be expected that improvement or cure of the cervical lesion or the shoulder-girdle lesion would be followed by disappearance of the signs of a scalenus anterior syndrome. This is true with three exceptions. If the syndrome is superimposed upon a fertile soil (an individual having the sloping-shoulder type of posture), once the cycle of muscle spasm has been initiated, it cannot be broken unless the posture is altered or the muscle is tenotomized. As has been stated, if an initiating shoulder-girdle lesion has been present sufficiently long, the scalenus anterior muscle may be either hypertrophied or contracted, or both. In either of these latter two circumstances, although the primary etiological factor has been removed, complete recovery may again depend upon sectioning of the scalenus anterior muscle.

Twenty cases of scalenus anterior syndrome, associated with various lesions of the shoulder girdle and of the cervical spine, have been studied quite thoroughly. Numerous additional cases presenting rather evanescent signs of this syndrome have been followed in the Out-Patient Dispensary and in office practice. Of the twenty cases studied, six were associated with lesions of the supraspinatus or of the short rotator tendons of the shoulder; four, with arthritis of the shoulder, one case being bilateral; three, with the anatomical type initiated by strenuous exercise or a lesser trauma; three, with fracture of the clavicle; one, with an old traumatic arthritis of the cervical spine; one, with an infectious arthritis of the cervical spine; one, with an old unreduced dislocation of the shoulder; and one, with a traumatic subluxation of the third cervical

* The evanescent signs of the scalenus anterior syndrome associated with supraspinatus lesions were brought to the author's attention by Dr. William A. Bishop, Jr., Orthopaedic Resident, Cincinnati General Hospital.

vertebra on the fourth. In this series of twenty cases, the majority were examined by neurologists who noted definite neurological changes. In half of the cases, careful oscillometric tests were carried out in the Vascular Clinic of the Cincinnati General Hospital, and changes corresponding to the severity of the lesions were noted. All cases have been studied roentgenographically, and supernumerary ribs and other anomalies have been excluded. The osseous lesions mentioned were demonstrated by the roentgenographic studies. In none of this series were there findings that suggested primary nerve lesions such as alcoholic or heavy-metal neuritis, or lues. In this series, extensive muscle weakness or paralysis was found only in cases of more than two months' duration. Likewise, with two exceptions, in cases of more than two months' duration the prompt disappearance of signs of the scalenus anterior syndrome did not accompany the conservative therapy confined to the primary cervical lesion or the shoulder-girdle lesion. In this series, the scalenus anterior muscle was tenotomized in five instances: one case of traumatic arthritis of the fourth cervical vertebra with a scalenus anterior syndrome of eight months' duration; one case of old traumatic arthritis of the fifth, sixth, and seventh cervical vertebrae with a bilateral scalenus anterior syndrome of three years' duration; two cases of the anatomical type of two weeks' and three months' duration, respectively; and one case of twenty-eight years' duration with symptoms of varying degree following a severe pyogenic infection of the hand associated with axillary and supraclavicular adenitis.

Since the association of the scalenus anterior syndrome with lesions of the cervical spine and of the shoulder has been recognized, therapy has been directed first to the primary lesion, and second to the syndrome. This plan of therapy has clarified the picture considerably. In numerous instances, the annoying and often distracting signs of the syndrome have vanished with the efficient management of the primary lesion. Adequate external or mechanical splinting of fractured clavicles or of painful lesions of the shoulder has resulted almost miraculously in the disappearance of the neurological and vascular signs of the scalenus anterior syndrome. In several instances—two lesions of the cervical spine and one malunited fracture of the clavicle—traction in the line of deformity has been the method of therapy. (See Figures 3-A and 3-B.) It can be argued that this traction has not only aided the primary lesion, but likewise has directly overcome the scalenus anterior spasm. In fact, it is the author's opinion that if time is of less importance and gradual recovery rather than immediate relief is expedient, traction applied to the arms or to the head, as the case may indicate, offers the ideal conservative therapy. Tenotomy of the scalenus anterior may always be resorted to if conservative therapy is unsuccessful.

In this series of twenty cases, those patients subjected to tenotomy of the scalenus anterior muscle were all relieved of pain, although in the presence of actual muscle weakness muscle power returned rather slowly,

as would be expected. In the case of the long-standing arthritis of the fifth, sixth, and seventh cervical vertebrae with the bilateral scalenus anterior syndrome of three years' duration, there was considerable muscle weakness of the shoulder girdle and forearms associated with neuritic pain. Under local anaesthesia, a scaleniotomy was performed on one side, with marked subsidence of pain and some return of muscle power. This patient has not returned. One patient with bilateral scalenus anterior syndrome and unusually sloping shoulders (Fig. 1) obtained sufficient relief from postural instruction so that operation was not indicated. Several patients, following moderate relief from conservative therapy, have refused scaleniotomy, although operation probably would have given complete relief.

In summarizing the results of conservative therapy in this series of twenty cases and a larger series of out-patient and office cases, it is the opinion of the author that in the presence of a syndrome of three months' duration with definite muscle weakness and signs of vascular interference, scaleniotomy should probably be done. However, sufficient improvement has followed conservative therapy in many instances to warrant its trial in all but the most extreme cases. In this series, the one exception was made in the case of a fireman who developed the scalenus anterior syndrome following ladder drill and had such excruciating pain that he had not slept for ten nights. He stated that, following the scaleniotomy under local anaesthesia, he noted, while he was being returned on a stretcher from the operating room, that the pain had disappeared entirely. He has remained cured since the operation.

From the study of the cases mentioned in this discussion, it is the opinion of the author that the diagnosis of brachial neuritis should not be made unless it can be substantiated by a neurologist who likewise understands the multitudinous associations of the scalenus anterior syndrome, and can attribute the neuritis to a proved etiological factor.

CONCLUSIONS

1. The scalenus anterior syndrome, a lesion of combined vascular and neurological signs and symptoms in the shoulder, the arm, and the hand, may be dependent upon an anatomical type plus a lesser trauma or strain of the shoulder girdle.

2. Lesions of the cervical spine may induce spasm of the scalenus anterior muscle with the resultant syndrome.

3. Traumatic and infectious lesions of the shoulder girdle may induce or be associated with the scalenus anterior syndrome.

4. When cervical or shoulder-girdle lesions are amenable to therapy, the scalenus anterior syndrome may subside without specific therapy.

5. In the anatomical type, or in the long-standing scalenus anterior syndrome from other causes, with hypertrophy or contracture of the scalenus anterior muscle, scaleniotomy is indicated.

6. Indiscriminate scaleniotomy in all cases of the scalenus anterior

syndrome is not indicated, as conservative therapy has resulted in the cure of cases in the past and will continue to do so in the future if the etiological factor is removed in a reasonable period of time.

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GIANT-CELL TUMOR OF BONE *

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The giant-cell tumor was recognized more than a hundred years ago by Sir Astley Cooper, who, in 1818, described the following physical signs: swelling, expansion of bone, ulceration, sloughing, and bloody discharge. The benign nature of the tumor is said to have been pointed out first by Lebert in 1845. Later, Paget, in 1853, gave what Bloodgood declared to be the most accurate description of the tumor ever published. In a lengthy monograph, Nélaton, in 1860, described in full the gross, microscopic, and clinical features of the disease, and emphasized the fact that it is only locally malignant. Two years later, Virchow suggested that the giant-cell tumor might recur and might even prove malignant. He alluded to the "degeneration into cancer" spoken of by authors since Paré and Fernel. In opposition to this, Gross, in 1879, gave a detailed analysis of seventy cases and insisted on the benign character of the lesion. He pointed out the difficulty of distinguishing it from the malignant medullary sarcoma of aneurysmal type.

In more recent years, Bloodgood, Codman, and William B. Coley have contributed conspicuously to our knowledge of this tumor, as have Nové-Josserand and Tavernier, Platt, and Barrie.

We find Pfahler and Herendeen in the vanguard of the steadily increasing number of radiologists who are staunch advocates of radiation for this type of tumor.

Among the pathologists of our day to whose intensive and painstaking study we owe much of our knowledge of the nature of the giant-cell tumor, are Ewing, Mallory, Goforth, and Stewart.

Finally, and of outstanding importance, is the part played by the Registry of Bone Sarcoma of the American College of Surgeons. This Registry, founded some two decades ago by Codman, has served as a clearing-house of information bearing on the results obtained by various methods of treatment, and on ultimate prognosis.

ETIOLOGY

Despite the variety of opinions offered by careful observers, the causative factor responsible for the giant-cell tumor has not as yet been definitely determined. Several theories have been advanced. Among them may be mentioned: (1) the *neoplastic* theory, which assumes a true tumor originating in bone marrow; (2) the *non-neoplastic* theory, which holds the condition to be not a tumor but a result of chronic inflammation or chronic irritation,—*i.e.*, faulty-repair phenomenon (Mallory) or chronic hemorrhagic osteomyelitis (Barrie); (3) the *traumatic*

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theory, which assumes that an injury induces a subcortical hemorrhage in cancellous bone, and the area involved extends gradually and progressively destroys more and more bone. Codman has elaborated on this theory. He feels that it explains the nature and growth of the giant-cell tumor. In his opinion: "The essential structure of a giant cell tumor is simple, for it contains no walled blood vessels and the corpuscles circulate through its interstices as if it were a sponge. Therefore, the whole sponge pulsates and tends to expand its bony walls by destroying its rigid boundaries. It does not advance down the soft marrow because the latter also pulsates with the same heart beats, nor does it invade joint cartilage which is elastic and accustomed to the intermittent pressure of weight bearing . . . I conceive the lumen of the artery which supplies it to be in direct communication with the interstices of the sponge and the emissary veins to be likewise the recipients of the corpuscles which have threaded their devious ways through the sponge. . . . The giant cells are not free. . . . They are nodes in strands of tissue remarkably evenly spaced throughout the cavity and line its walls. Complications in this simple picture include hemosiderin in nearly every case, indicating a traumatic origin."

In connection with the last-named theory, we would point out that the series of giant-cell tumors of long bones reported by William B. Coley showed a history of antecedent trauma in 50 per cent., and the Johns Hopkins series (Geschickter and Copeland), in 42 per cent. We believe that the *traumatic* theory offers the most logical explanation.

LOCATION

The giant-cell tumor is primarily an affection of the long bones of the extremities, occurring but infrequently in flat bones. It originates

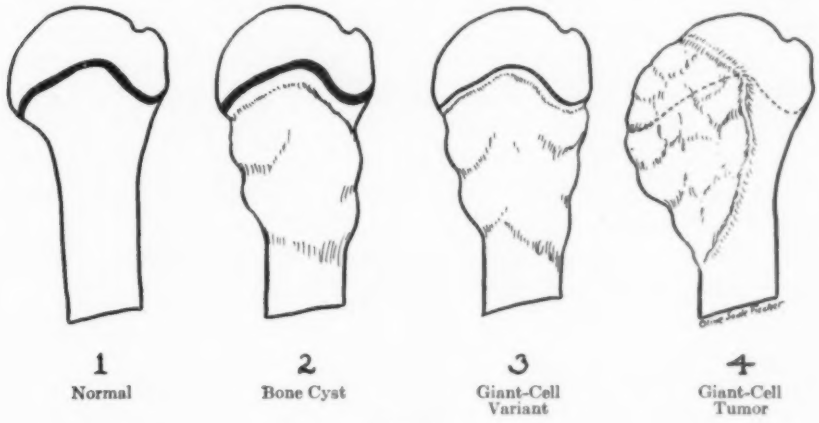

FIG. 1

Schematic drawing showing location, in respect to the epiphyseal line, of the involved area in bone cyst (*2*), giant-cell variant of bone cyst (*3*), and giant-cell tumor (*4*).

Note especially the proximity of the process to the epiphyseal line in *3;* also that the epiphysis is about to unite. Note also that in *4* the process involves the head rather than the shaft side of the epiphyseal line (now united), although it extends across to involve the metaphyseal area somewhat.

TABLE I

LOCATIONS OF GIANT-CELL TUMORS

Site	Series from Memorial Hospital and Hospital for the Ruptured and Crippled (124 Cases)			Schinz and Uehlinger's Series Collected from Literature (385 Cases)		
	Cases	*Proximal*	*Distal*	*Cases*	*Proximal*	*Distal*
Femur	37	6	31	139	16	123
Tibia	37	35	2	106	92	14
Radius	8	1	7	65	3	62
Humerus	6	5	1	27	27	0
Ulna	2	0	2	29	7	22
Fibula	6	5	1	19	15	4
Ilium	7					
Sacrum	6					
Ischium	3					
Calcaneum	3					
Vertebra	3					
Metatarsal Bones	2					
Metacarpal Bones	1					
Phalanx	1					
Rib	1					
Pubis	1					

in the epiphyseal region, and extends progressively with little tendency to destroy the adjacent shaft until late in its course. By far, the most frequent sites are the femur, the tibia, and the radius. In a series of 385 collected cases, these three bones were involved in 310 cases. For a detailed description see Table I.

No examples of tumor of the patella were found in our series, but fourteen are mentioned in the literature.

The giant-cell tumor is a solitary lesion. Rare published reports of multiple involvement are, probably, examples of generalized osteitis fibrosa cystica with giant-cell tissue. However, we have once seen both femora affected at different periods, and have twice seen the process extend to a contiguous bone,—*i.e.*, from the lower tibia to the lower fibula across the inferior tibiofibular articulation, and from the upper femur across the hip joint to the acetabulum. Although of less frequent occurrence than the central chondroma in this location, the giant-cell tumor may originate in the small bones of the hands and feet.

PATHOLOGY

The complexities of the histogenesis of the giant-cell tumor are well known. Pathological opinion differs widely. A comprehensive discussion of the subject is out of place in this paper, and those interested are referred to original sources.

Despite the advancement of many arguments that the giant-cell tumor is not a true tumor, its behavior and course reveal certain features that lead most present-day writers to regard it as such. It is difficult to conceive how a lesion that possesses the power of persistent growth and the tendency to recur after incomplete removal and to invade the adjacent tissues, and even in some instances to develop metastases, can be regarded as a chronic inflammatory process. We believe that, although it is usually benign, it is always locally aggressive and even, in a sense, potentially malignant. This latter quality seems to be inherent in cases inadequately or improperly treated.

SYMPTOMS

Pain is usually the first symptom noted by the patient. It is not severe, it is often intermittent, and it seldom progresses as rapidly as in medullary osteogenic sarcoma. It is often described as a "dull ache" and is aggravated by activity of the part. Because of its central location, the giant-cell tumor does not give rise to a visible swelling or palpable tumor in the early stages. Later, when expansion of the cortex has taken place, a tumor may be noted by the patient or the examining physician. Disability is a variable factor; it occurs most frequently later in the disease after pain has been complained of, but often before the swelling appears. It is usually manifest in slight restriction of full range of motion of the nearby joint, and lameness after attempts at functional activity.

PHYSICAL SIGNS

Early lesions may present little in the way of objective findings for, as already stated, the changes in the bone (swelling and cortical expansion) are not early manifestations. Later there will be evidence of increase in size, interference with full range of motion, and, occasionally, increased surface temperature, and even, in rare instances, pulsation of the thin shell covering the tumor.

ROENTGENOGRAPHIC FEATURES

This tumor usually presents a characteristic roentgenographic appearance. It shows a destructive area in the epiphyseal region which involves adjacent metaphyseal bone, but which exhibits little extension to cortical bone of the shaft. The area of involvement is irregularly spherical, shows trabeculations due to destruction of the cancellous bone,

TABLE II

AGE INCIDENCE OF GIANT-CELL TUMORS

Period	Series from Memorial Hospital and Hospital for the Ruptured and Crippled (124 Cases *)	Combined Series of Christensen (341), W. B. Coley (50) and Behring (26)—Total of 417 Cases
Years	*Cases*	*Cases*
0 to 10	1	23
11 to 20	21	106
21 to 30	48	150
31 to 40	30	63
41 to 50	16	49
51 to 60	6	19
61 to 70	2	7

* Oldest patient, 62 years; youngest, 5 years; average age of patients, 29.7 years.

and tends to extend across the bone to destroy the whole transverse diameter before progressing shaftward. While it may extend to the cartilage of the articulation, it seldom invades it, and even late in the disease this structure remains intact. When erosion has progressed sufficiently to expand the cortex, it may later destroy it so completely that no evidence of a bony shell is seen in the roentgenograms, and only the periosteum remains as a limiting membrane. When pathological fracture occurs, it is apparent on roentgenographic examination, although marked displacement is unusual. However, the affected side of the bone is usually compressed, so that tilting is seen and irregularity of the joint surface is produced.

AGE INCIDENCE

As will be seen by Table II, this disease is one of youth and early middle life, occurring most frequently in the decade from twenty-one to thirty years.

TABLE III

SEX INCIDENCE

Sex	Series from Memorial Hospital and Hospital for the Ruptured and Crippled (124 Cases)		Series of Christensen (362 cases)	
	Cases	*Per Cent.*	*Cases*	*Per Cent.*
Female	56	45	192	53
Male	68	55	170	47

TABLE IV

DIFFERENTIAL FACTORS

Factors	Bone Cyst	von Recklinghausen's Disease	Giant-Cell Tumor
Age	5 to 18 years	Young and middle-aged adults	Young adults (20 to 40 years)
Location	Metaphysis	Generalized, usually in shaft	Epiphysis
Bone Involved	Upper femur, humerus, and tibia	Many bones	Lower femur, upper tibia, lower radius, and upper humerus
Fracture	Frequent (50 per cent.)	Frequent	Less early, but in 25 per cent.
Gross Appearance	Multilocular, serous	Multilocular	Friable, reddish-brown, bloody
Appearance of tissue	Whitish	Fibrous	Reddish
Giant Cells	Present	May be present	Plentiful
Vascularity	Slight	Avascular	Very vascular, even telangiectatic
X-Ray Appearance	Typical	Typical	Typical
Chemistry	Normal phosphorus, phosphatase, and calcium	Calcium and phosphatase elevated; phosphorus diminished	Normal phosphorus, phosphatase, and calcium

SEX INCIDENCE

While in the second of the two series shown in Table III there is a slight preponderance of females over males, we do not believe that the relationship of sex plays an important part.

DIFFERENTIAL DIAGNOSIS

In a recent article Codman states that there are three possibilities of error in making a diagnosis of giant-cell tumor from roentgenograms, and two from microscopic sections:

1. The films may be characteristic and yet the sections may be unequivocally in favor of some other diagnosis.

2. Both films and slides may be interpreted as giant-cell tumor and yet the rapid fatal course may indicate an error of interpretation.

3. The films, sections, and clinical course for several years may seem to assure the diagnosis and yet a sarcoma may eventually appear at the site of the lesion.

There are many bone lesions to be distinguished from the giant-cell tumor,—some are malignant, some are benign, and some are not neoplasms at all. Table IV presents the distinguishing factors and shows that age

and consequent relationship to the epiphyseal line are the most important elements to be considered in trying to differentiate them.

Simple Bone Cyst

This condition is most often confused with giant-cell tumor. They have many factors in common. The etiology and pathology are quite similar. Sabrazès, Jeanneney, and Mathey-Cornat, in their introductory remarks on giant-cell tumor, bone cyst, and fibrous osteitis, point out that the nature of these three conditions is not well understood, and that transitional forms may be found. They prefer to retain them under the classification of *tumors*, rather than, as Lecène and others have designated them, as *lésions dystrophiques des os*, although recognizing that their prognosis is infinitely better than that of true malignant tumors.

Von Recklinghausen's Disease

This disease (multiple form of osteitis fibrosa cystica) seldom offers diagnostic difficulty because the lesions are multiple and involve the shaft; in fact, except for the microscopic picture, it bears no similarity to the giant-cell tumor. The blood chemistry is important, for in both bone cyst and giant-cell tumor the serum calcium, phosphorus, and phosphatase are normal; whereas in von Recklinghausen's disease the calcium and phosphatase are increased and the phosphorus is diminished.

Central Chondroma or Chondromyxoma

This condition, when occurring in the epiphysis of a long bone, occasionally simulates a giant-cell tumor; the roentgenograms may even be indistinguishable. Since conservative treatment is in order for each, the diagnosis will ultimately rest on the microscopic evidence obtained either by aspiration or at operation.

Plasma-Cell Myeloma

This disease affects individuals who have passed the age period when giant-cell tumor is ordinarily found, yet there is a slight overlapping about the age of forty when the two may occur. In this small group, the solitary form of myeloma, especially when occurring in a flat bone such as the ilium, may resemble a giant-cell tumor very closely, and may require histological study for differentiation.

Osteogenic Sarcoma

The consideration of this type of bone tumor will be restricted to the form called the *medullary osteolytic* variety. This tumor often selects the same site in the bone, occurs in the same age group, has in its earlier stages a similarity of symptoms and signs, and even resembles the giant-cell tumor roentgenographically. We have encountered a number of cases that had been regarded as giant-cell tumors and treated by radiation over a long period, only to require amputation when it had become

obvious that the lesions were malignant osteolytic sarcoma and not benign giant-cell tumor. This may happen whenever a supposed giant-cell tumor is treated by radiation without microscopic confirmation of the diagnosis.

MALIGNANT GIANT-CELL TUMOR

The question of the possible transformation of a benign giant-cell tumor into a sarcoma has been raised and discussed for more than a hundred years. It has aroused the interest of nearly every worker in the field. We have studied our cases with this question in mind, and, in an as yet unpublished paper written in collaboration with Dr. Fred W. Stewart, an effort has been made to interpret the malignant evolution of the giant-cell tumor.

From this study, we have reached the conclusion that the form assumed by the process known as the giant-cell tumor depends on the nature of the circumstances, physical and chemical, which have initiated the process, together with the extrinsic factors which interfere with its normal evolution.

From a practical standpoint, one should bear in mind that infrequently, but by no means rarely, a giant-cell tumor may exhibit all the characteristics of a benign lesion, even to the histological appearance, and yet run a course that shows it to be a malignant sarcoma. We are convinced, however, that, when this malignant change takes place, the sarcoma is not osteogenic sarcoma in the usually accepted sense, but a wholly distinct type. It shows no tendency to form bone, cartilage, or osteoid tissue. One of the confusing factors which we found was the similarity between cases apparently malignant at the outset before any treatment had been given and those in which malignant features developed at a later date following curettage or radiation or a combination of both. Some of our cases, however, in which this combined treatment was employed seemed to show so clearly a malignant transformation from an apparently benign state that we have continued to deprecate the practice.

TREATMENT

Up to this time, two conservative methods have been devised for the treatment of giant-cell tumor,—surgical extirpation by curettage or resection, and radiation by radium pack or roentgen-ray. More radical surgery, such as amputation, is reserved for frankly malignant cases or for the exceptional case in which the tumor is situated in the lower extremity where an artificial limb assures a better functional result.

The question is not yet finally settled as to whether radiation or surgery is the better method. Some extremists would never resort to surgery, but would treat all by the roentgen-ray; others, equally extreme, would use surgery in preference to the roentgen-ray, regardless of the size, the location, or the extent of the lesion. The fact that opinion is so widely divergent would seem to indicate that neither extreme view is the

correct one, and that, until a more satisfactory answer has been found, the profession should retain an open mind on the subject. Several years ago we sent a questionnaire to a number of orthopaedic surgeons and radiologists in this country in an effort to obtain representative opinions regarding their choice of method of treatment. From their replies we learned that, for the most part, their conclusions coincided with our own,—namely, that it was best to reserve radiation for cases where the lesion was inaccessible, and to employ surgery for all others. As might be expected, we found that the surgeons more consistently favored surgery, and the radiologists, radiation.

Representative of British opinion, Platt, of Manchester, holds that "certain early giant-cell tumors should be curetted and others excised"; and Elmslie, of London, that "benign giant-cell tumors should always be treated surgically".

As has already been stated, our experience has led us to adopt surgery for lesions that are accessible, especially those situated in the region of the knee, and radiation for lesions that are inaccessible, especially those in the spine, in the pelvis, or in the neck of the femur. We avoid the use of radiation and surgery in the same case. Borderline cystic lesions and true bone cysts are treated according to the same criteria and following the same principles. It should be remembered, however, that, since cysts are usually seen in individuals who have not attained full bone growth, the effect of the roentgen-ray on the adjacent epiphysis may result in retardation of growth and consequent bone shortening. This is of more moment in the lower extremity. Cases of advanced giant-cell tumor, in which the bony shell has been completely destroyed, are sometimes unsuitable for operation. Some of these have responded well to radiation.

TECHNIQUE OF CURETTAGE

Since a full description of the technique employed appears in a previous paper published by the authors in 1936, only a brief reference to the more important points will be given here.

As our aim in all cases is perfect wound healing, particular emphasis is laid on a thorough skin preparation (we use a forty-eight-hour preparation). Protection of the wound edges with towels fastened with Michel clips is recommended. Uncontrolled bleeding may be forestalled by the use of an Esmarch bandage or tourniquet. Accurate hemostasis of soft tissues is essential. A large window cut in the cortex assures good exposure. The periosteum is preserved. The thoroughness with which the cavity is curetted is a measure of the probable successful result. The cavity is swabbed with zinc chloride and flushed with Dakin's solution or normal saline. The wound is closed layer by layer. Packing or drainage of the wound is strongly condemned. Firm, snug dressings of gauze-roll and sheet-wadding, held by flannel bandage reinforced with adhesive strips, maintain pressure evenly and help prevent wound

infection by avoiding hematoma. Elevation of the part for from forty-eight to seventy-two hours minimizes swelling and prevents excessive oozing. The wound is not disturbed for a week. If the degree of involvement suggests the danger of a pathological fracture, protection by splints or by plaster casings is provided. Weight-bearing is avoided until regeneration of bone is believed to be adequate. Motion of the contiguous joint is encouraged at the earliest moment possible. Caliper splints for tumors of the tibia and femur permit walking, without danger of late fracture. This activity hastens bone regeneration. Appropriate splints are used for lesions in the upper extremity.

We have not found it necessary to use bone chips, and we believe it is unwise to fill the curetted cavity with them as has been recommended by some surgeons. Muscle and fat grafts are mentioned only to be condemned.

RESECTION

Subperiosteal resection in preference to curettage has been recommended by several authorities. Tumors of the upper fibula, of the metatarsus, and of the rib may be satisfactorily handled in this manner. However, curettage has been followed by recurrence so infrequently in our experience that the occasion for resection has seldom arisen. It may be useful in the recurrent case in preference to a second curettage.

AMPUTATION

Only on extremely rare occasions should it be regarded as necessary to amputate a limb. In the past, amputation had to be resorted to in some cases in which the wound was packed following curettage, or in which infection and fungation followed the use of radium implanted in the cavity. Since the technique of operation has been altered and the wounds invariably closed without drainage, we have never amputated except where a malignant transformation of the tumor has taken place. Several cases have come to amputation following radiation because of complications or sequelae such as radiation osteitis with fracture and non-union, ulceration, infection, etc.

RADIATION THERAPY

While both the radium pack and the roentgen-ray are used in the treatment of giant-cell tumors, the latter has many advantages over the former. It is widely available in every large city, it is more economical, and a shorter time is required to deliver a comparable dose.

In the past, the doses of roentgen-ray employed were often much too large or were repeated too frequently, so that many of the unfortunate end results are chargeable to overtreatment.

One difficulty has been that a dose adequate for one patient was insufficient for another. No generally accepted standard of technique has been devised.

TABLE V

RESULTS OF TREATMENT OF 124 CASES† OF GIANT-CELL TUMOR

Treatment	Cases	Excellent Result		Good Result		Poor Result		Unclassified
	No.	*No.*	*Per Cent.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*	*No.*
Surgery alone...	35	17	57	6	20	7	23	5
Radiation alone	53	14	34	12	30	15	36	12
Surgery and radiation combined.....	34*	7	22	8	25	17	53	2
Coley's toxins alone.....	2	1	50	1	50			

* Of these thirty-four patients treated by surgery and radiation combined, thirty had postoperative radiation; in only four cases was preoperative radiation used. Of the latter, there was a recurrence in one and a second operation was required; in another the tumor became malignant shortly after curettage, amputation was performed and the patient died of metastases; three patients are living and well.

† It should be noted that the unclassified results were deducted from the total number of cases before the percentages were computed.

We believe that the present tendency to use smaller doses, to repeat the cycles less often or at longer intervals, and to withhold later treatment in the absence of symptoms and in the presence of a favorable roentgenographic appearance, is all sound practice. With it, we believe that better results will be obtained.

Furthermore, it is our view that, where experience in the surgical treatment of this condition is lacking, roentgen therapy is the safer procedure.

Technique of Radiation of Giant-Cell Tumor

It is the feeling at the Memorial Hospital that a voltage of 200 kilovolts is employed too frequently, and that, from the standpoint of selec-

TABLE VI

ANALYSIS OF TWENTY-SIX * CASES OF GIANT-CELL TUMOR IN WHICH AMPUTATION WAS PERFORMED

Secondary Amputation (24 Cases)	Type of Previous Treatment		
	Surgery	Radiation	Combined
For infection	2	0	2
For radiation changes	0	4	2
For malignant transformation	1	0	6
For failure to control disease	2	3	2
Total	5	7	12
Percentage of followed cases	17	17	37

* Primary amputation was done in two cases; secondary amputation in twenty-four.

TABLE VII

SUMMARY OF RESULTS OF TREATMENT IN 124 CASES OF GIANT-CELL TUMOR AT MEMORIAL HOSPITAL AND HOSPITAL FOR THE RUPTURED AND CRIPPLED

Results		Patients
Alive and under observation		83
Lost to follow-up		19
Dead:		
Causes related to bone tumor	14	
Causes unrelated to bone tumor	4	
Causes unknown	4	
	—	22
Total		124

tion of physical factors, for a tumor occupying a relatively superficial position—around the knee where the majority occur—a lower voltage, say, from 125 to 150 kilovolts with a four-millimeter aluminum filter, at a target-skin distance of from twenty-five to thirty centimeters is preferable. Moderately heavy doses are given with the above factors, a suberythema or threshold dose (approximately 500 roentgen units, depending on the size of the part) being administered at a single treatment. The ports are treated at intervals of from four to seven days. A cycle might consist of four exposures,—two to each port.

It must be clearly understood that these doses are rough approximations only, and that, due to the marked variations in radiosensitivity, there is no standard method or dosage in the roentgen-ray treatment of giant-cell tumors.

The same principles of adequate support during the period when bone regeneration and repair are taking place hold for cases treated by radiation as obtain for those treated by curettage. As a rule, however, regeneration and healing require a much longer period under radiation than under surgery, so that in the former group the casts and braces must be worn over a much longer period.

RESULTS

For a full explanation of the results obtained by the various methods of treatment see Tables V, VI, and VII.

It will be noted that surgery alone yielded the largest proportion of excellent results and the smallest proportion of poor results, that radiation alone gave the next best, and that combined surgery and radiation gave the poorest results. Coley's toxins were employed without any other treatment in two cases; in one, the result was excellent; and in the other, good.

An analysis of the twenty-six cases in which amputation was performed (Table VI) shows that in two cases amputation was performed as a primary measure; in twenty-four, as a secondary measure because of some complication such as infection, radiation osteitis or soft-tissue damage, failure to control the disease, or malignant transformation.

A noteworthy fact, and one that we have previously pointed out, is that, while 17 per cent. of the cases treated by surgery alone and 17 per cent. treated by radiation alone later came to amputation, in a third group, treated by radiation and surgery combined, this drastic operation was required in a much larger percentage of cases,—namely, 37 per cent.

CONCLUSIONS

1. The giant-cell tumor is usually benign, but malignant forms are encountered and may result from the transformation of a tumor that is histologically benign at the outset.

2. Surgical extirpation (curettage, resection, and, on rare occasions, amputation) and radiation have been established as successful methods of treatment. Surgery is preferable for accessible tumors, and radiation for inaccessible or extremely advanced tumors.

3. Caution should be exercised when using the roentgen-ray without histological confirmation of the diagnosis, for one may be dealing with an osteolytic sarcoma which bears a close resemblance, roentgenographically, to the giant-cell tumor.

4. Radiation should not be used in conjunction with surgery. Each method should bear the full responsibility of its employment in the individual case.

5. The roentgen-ray in large doses destroys the regenerative powers of the bone; in small doses, it may fail to arrest the disease; therefore, the exact dosage for the individual case is a matter of profound judgment or of fortuitous circumstance.

6. Inexpert radiation is probably less hazardous than surgery in the hands of one unfamiliar with technical operative details. Loss of limb may ultimately result in either instance.

7. Surgical attack should envisage thorough removal of all tumor tissue through adequate exposure, careful wound closure without packing or drainage, and primary wound healing.

8. Protection during the regenerative phase is essential, regardless of the treatment employed, for a pathological fracture usually spells functional impairment and a painful neighboring joint.

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THE MECHANICS OF THE FORMATION OF THE "SECONDARY ACETABULUM" IN CONGENITAL DISLOCATION OF THE HIP

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Lorenz, in his monograph published in 1920, claimed that dislocation of the head of the femur from the acetabulum occurs only after birth and that all cases in which dislocation occurs before birth are of a teratoid nature and, combined with other deformities, occur very infrequently. He, therefore, regarded these luxations of the hip as "so-called congenital". Since the appearance of this monograph, Harrenstein and others have described many cases in which dislocation was determined as having occurred before birth and still further cases in which dislocation of the hip was demonstrated within the first few hours or days of life. These facts led Hilgenreiner to deny the assumption of Lorenz.

Every observer of considerable experience in closed reduction of congenital dislocation of the hip recognizes certain cases in which reposition of the head either cannot be accomplished or can be attained only with great difficulty. For years the author has been studying to determine the reason for this and has been led to the supposition that perhaps those cases in which reduction is impossible or extremely difficult, in spite of the fact that the patients are of the age when this manoeuver is generally easily accomplished, are of "true congenital" nature. To verify this, the author has examined the mechanics of the formation of the secondary acetabulum.

FIG. 1

Patient, two years of age. Congenital dislocation of the hip combined with other severe deformities (club-foot, loss of one ear, cryptorchidism).

FIG. 2

Patient, five months old. Congenital dislocation of the hip combined with other deformities (luxation of one knee and slight club-foot).

The formation of the secondary acetabulum in true congenital dislocation must differ mechanically from that in so-called congenital dislocation. If the luxation occurs during the embryonic stage, the secondary acetabulum is the effect of the continuous pressure of the head against the wall of the ilium. The site of attachment remains the same until birth, with the result that the groove which is produced by the pressure of the ever enlarging head becomes constantly deeper, and finally resembles a physiological acetabulum (Fig. 1). The borders of this newly formed acetabulum surround the head on each side, but the upper border is particularly well developed (Fig. 2).

In dislocations occurring after birth, the secondary acetabulum is formed in quite a different manner, and is the result of friction of the gliding head on the ilium. The shape of the newly formed acetabulum has no resemblance to the normal one. The head of the femur, due to lack of

FIG. 3

Patient, two and one-half years of age. Congenital dislocation of the hip.

muscle control, glides freely in each direction on the wall of the pelvis during each movement of the leg. As a result, the secondary acetabulum is large and shallow and, with the occasional exception of the lower edge, is without well-formed borders. (See Figure 3.)

These facts seem to be of great pathognomonic and diagnostic importance. In the so-called congenital cases, the secondary acetabulum has a well-shaped lower border; in the true congenital cases, a well-shaped upper border. In the former, the head forms its socket by gliding and rubbing; in the latter, by direct pressure.

The reason for the difference in location of the definitely formed border is evident. In the so-called congenital cases, the gliding head has but one fixed point from which it starts during the movements of walking, etc., and to which it always returns and remains during rest. Therefore, this area on the ilium becomes well shaped and firm and corresponds to the lowest point to which the head returns in function and in rest. During the night, the head clings to the ilium and deepens the socket still further, as it does in the true congenital cases. In the latter, the boring head cannot, in functioning, extend beyond its upper border which is firmly formed in the embryonic stage. During all movements, particularly in walking, the head always returns to this area and, by its pressure, constantly increases the depth of the groove. If one takes into consideration the depth of the groove of the secondary acetabulum in cases of true congenital dislocation, together with the fact that its borders are sometimes almost as firm and well defined as are those of the physiological acetabulum, one can easily understand why reduction in these cases is difficult or even impossible, for, in later stages of dislocation, reposition of the head into the physiological acetabulum has to be preceded by dislocation from the secondary acetabulum.

These cases were recognized in the early part of the author's studies by observing all other deformities in the same individual. (See Figures 1 and 2.) Examination of the material showed that in cases with the deep groove and well-developed upper and lower borders of the secondary acetabulum, especially when combined with other anomalies, reposition of the head was difficult or impossible.

The true congenital cases are in a very great minority. The author believes that the evidence obtained from his study not only demonstrates the manner of formation of the secondary acetabulum and supports the theory of Lorenz, but may also aid in establishing the prognosis in regard to the final result of treatment of congenital dislocation of the hip.

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PRIMARY HEMANGIOMA INVOLVING BONES OF THE EXTREMITIES

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Primary hemangioma of bone is a relatively uncommon tumor. Prior to the roentgenological description by Hitzrot in 1917, the condition had been limited to a pathological entity. Bucy and Capp in 1930 collected forty-seven cases which presented clinical symptoms and which were definitely proved pathologically. In twelve of these cases, the vertebrae were involved; in eleven, the bones of the extremities; and in the remaining twenty-four, various other bones. Töpfer collected 257 cases of non-symptomatic primary hemangioma of bone during 2,154 autopsies. The vertebrae were involved in all cases and there were thirty-four instances of multiple lesions. The extremities were affected in only three cases.

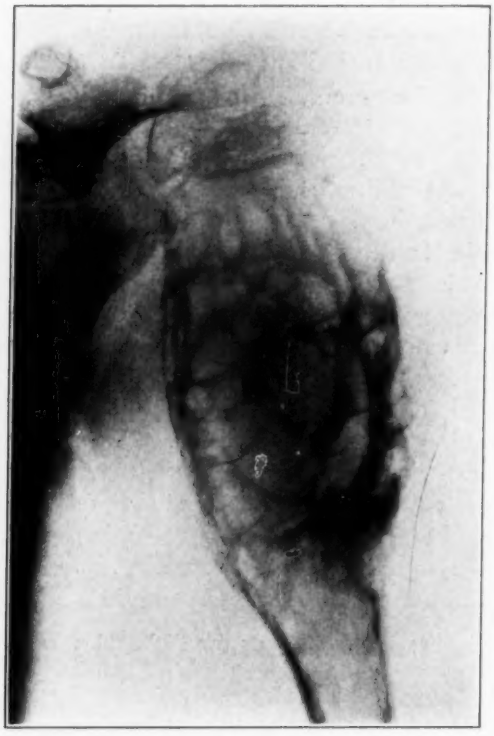

FIG. 1

Case 1. Hemangioma of the humerus.

The present review of the literature is supplemental to that of Bucy and Capp. We were able to collect forty-nine references, since 1930, pertaining to primary hemangioma of bone. In this series of references there was one questionable case and sixteen proved cases of hemangioma. In three, the maxilla was affected; in one, the nasal cavity, the maxilla, and the base of the skull; in another, the hard palate, the pharynx and the larynx; and in five, the orbit. In the remaining seven, the vertebrae were involved. The questionable case was one of angioma of the skin with possible secondary involvement of the long bones.

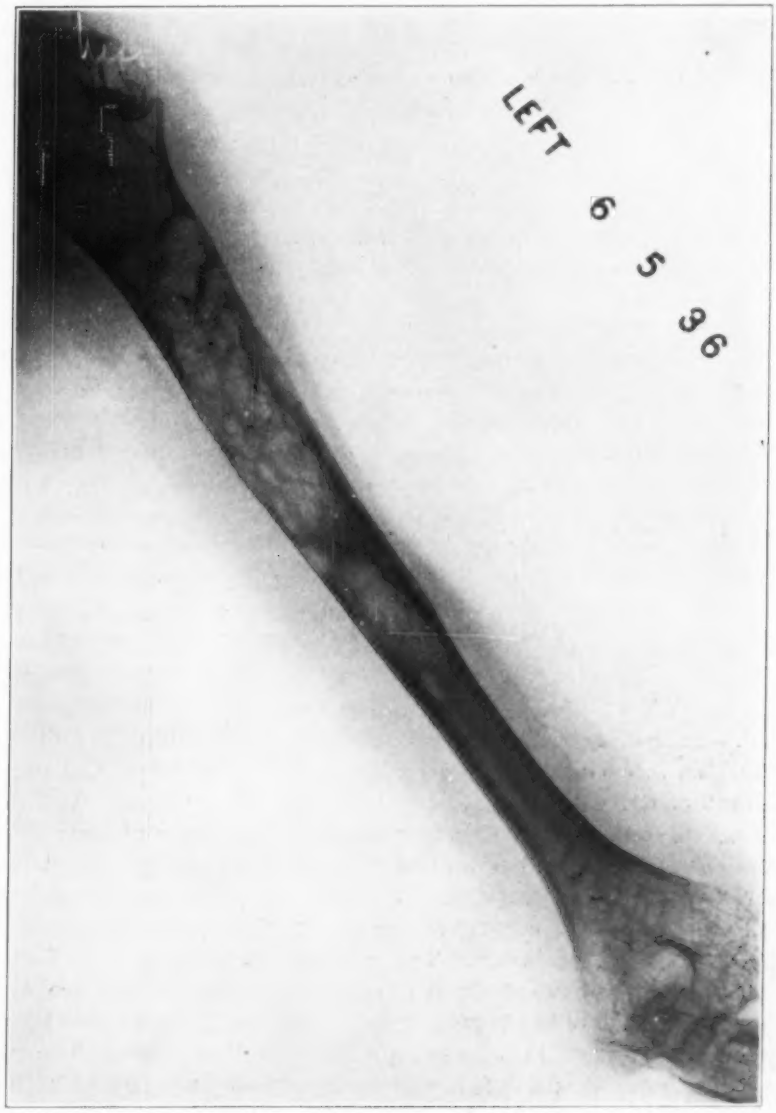

FIG. 2
Case 1. Two years later.

None of the reports since the review of Bucy and Capp gave proved cases involving bones of the extremities.

The total number of reported cases of symptomatic primary hemangioma involving bones of the extremities is, therefore, eleven. Four additional cases are reported herein.

CLINICAL FEATURES

The youngest patient was eight; the oldest, twenty. There was an

FIG. 3

Hemangioma of the ulna. Duplicate of Case 849, Registry of Bone Sarcoma.

equal distribution in regard to sex. Three of the four patients gave a history of trauma,—two had had pathological fractures and the third had sustained a crushing injury.

The ages in the series of Bucy and Capp, including all sites of involvement, ranged from ten to seventy-six years; the average age was 37.36 years. Trauma occurred in three instances and a fracture in one. The series included twenty-four males, seventeen females, and six patients whose sex was unreported.

In Töpfer's autopsy findings, the percentage of females was 54.

ROENTGENOGRAPHIC FINDINGS

Haas and Codman emphasized the presence of small locules in lesions of small bones. Similarity between the roentgenographic findings of giant-cell tumor and hemangioma was observed. Pohl described a fine fibrillary framework within the individual locules. In some instances the cortex overlying the expanded portion of the tumor was destroyed.

Roentgenographic findings in primary hemangioma of bones of the extremities in the present series resemble those of bone cyst or giant-cell tumor. Figure 1 shows an expansile tumor extending from the epiphysis distally to involve one quarter of the shaft. The cortex, except for the point of fracture, is intact. The medulla and the replaced cortex are trabeculated. Several small punched-out areas can be seen distal to the lower border of the tumor. These areas are of importance because they indicate progression and are typical of an actively growing angiomatous lesion in any tissue. This phenomenon should be stressed in future observations of primary hemangioma of bone. Figure 2 is a roentgenogram of the same arm two years later. The original cyst has been curetted and is now healed, but there is progression of the lesion distally in the medullary cavity. The cavities formed may now be described as small locules. The walls of these locules possess a heavier framework than those of giant-cell tumors. When compared with the changes in Figure 3 (Case 849 of the Registry of Bone Sarcoma, which was also referred to the surgical pathological laboratory of the Johns Hopkins Hospital) one can see a great similarity. The framework of the locules in both instances is heavy and of diagnostic significance because this is not common to other tumors. The similarity between the roentgenogram

FIG. 4

Case 2. P. N. 57674. Hemangioma of the radius.

FIG. 5

Case 3. P. N. 54290. Hemangioma of the humerus.

of primary hemangioma and cystic lesions in the long bones is again emphasized by the changes shown in Figure 4. The tumor, which involves the distal two thirds of the radius, is expansile and lobulated. The lobules are fairly large, and the cortex is intact. There is a striking resemblance to a giant-cell tumor, but the extensive osseous involvement is suggestive of angioma. Figure 5 is a roentgenogram of a hemangioma of the upper end of the humerus. It is a typical picture of a cystic lesion in which a pathological fracture has occurred. It differs from the previous lesions in that the tumor is localized to a more restricted portion of the shaft and in the complete absence of lobules or locules. There is no tendency to expansion. A benign bone cyst is simulated. The fourth case studied is that of a malignant primary hemangioma of the os calcis, which closely resembles the roentgenographic changes, due to primary hemangioma, seen in the astragalus of Case 249 of the Registry of Bone Sarcoma (Bucy and Capp). The lesion in Figure 6 consists of numerous small lobules of various sizes. The lobules are ill defined, and the lesion has no tendency to expand. Here again, the changes are those of a cystic lesion.

It may be concluded that the roentgenographic changes of primary hemangioma of bones in the extremities are similar to those of benign giant-cell tumor or osteitis fibrosa cystica, but they may present several significant features. First, the lesion tends to progress and may be more extensive than those commonly found in the other cystic or expansile lesions under consideration. Second, the locules, when present, are smaller than the lobules of benign giant-cell tumor or benign bone cyst, and are bordered by a much heavier framework of osseous tissue.

GROSS PATHOLOGY

The gross appearance, general consistency, and color of the pathological tissue varies. Case 1 was a capillary hemangioma. The surgeon found, at operation, that the cortex had become very thin. In places he could cut through the tissue with scissors, and there was evidence of a broken capsule which permitted the escape of fluid. The medullary cavity and part of the cortex were replaced by a cystic cavity containing a clear straw-colored fluid. The cavity walls contained no capsule, but a small amount of material resembling a blood clot was obtained on curettage. Similar changes were found in Case 2. The third case showed an interesting pathological picture. The specimen shown in Figure 7 was available for study. The pathologist, to whom the biopsy material had been submitted, made a diagnosis of sarcoma. The arm was dis-

FIG. 6

Case 4. P. N. 37954. Angiosarcoma of the os calcis.

articulated at the shoulder joint. The tumor consisted of a mass about seven centimeters in diameter and was well circumscribed and surrounded by a definite wall of bone. The enclosed material was mucoid and red in color. It was grayish in spots and had the general appearance of angioma. In Case 4, an angiosarcoma, the surgeon, at operation, found a small bluish tumor attached and protruding through the periosteum of the os calcis. No attempt was made at the first operation to explore the bone. At the second operation, the calcaneum was found to be replaced in part by two cystic cavities which contained grayish-red granular material. Sufficient data are not available to permit us to determine whether the angioma had its origin in the bone proper or in the periosteum covering it.

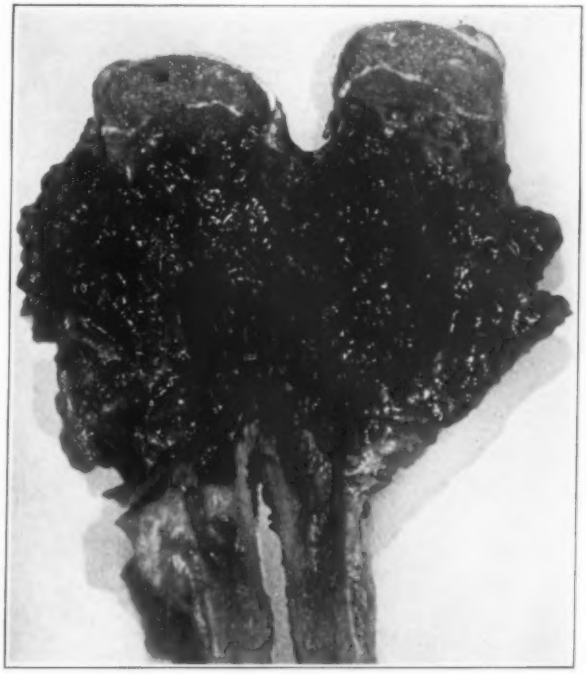

FIG. 7

Photograph of gross specimen of angioblastoma of upper end of humerus. (See Fig. 5 for x-ray changes.)

Thus, primary hemangioma of bone gives rise to cystic cavities which contain no capsular lining. Like bone cysts, they may contain fluid or tumor tissue within the wall. The tumor material filling these cavities is apparently similar to the tissue of angiomatous tumors elsewhere.

MICROSCOPIC FINDINGS

Hemangioma of bone presents various microscopic features. Kümmel and Rockemer described a case of hemangioma of the nose, maxillary cavity, and skull, which was of the capillary form. Phemister reported a case of capillary hemangioma involving the clavicle. No reference has been made to angioblastoma. The cases reported in the literature were for the most part of the cavernous type.

In our series there was a capillary hemangioma, a cavernous hemangioma, an angioblastoma, and an angiosarcoma. The section of the capillary hemangioma (Fig. 8) shows areas of hemorrhage between which can be seen capillaries with their single layers of endothelium and hyaline contents. The tissue contains large cystic cavernous spaces filled with

FIG. 8

Case 1. P. N. 52672. Capillary hemangioma of bone. (Low magnification.)

red blood cells and an occasional lymphocyte or polymorphonuclear leukocyte. The second case is a cavernous hemangioma (Fig. 9). It presents irregularly shaped sinuses which contain coagulated material. These sinuses are lined by endothelium. Definitely formed capillaries and stroma containing young fibroblasts are interspersed between the many channels. The case of angioblastoma (Fig. 10) is the first to be reported in bone. This tumor consists of tortuous tubules which lie in a fibrous stroma. These tubules for the most part contain a colloidlike material. An occasional small capillary can be seen. The fourth case is a malignant

FIG. 9

Case 2. P. N. 57674. Cavernous hemangioma of bone. (Low magnification.)

angioma (Fig. 11). It does not present the features of a Kaposi tumor, nor is it comparable to the so-called angio-endothelioma. The tissue consists of many small cavernous spaces lined by single rows of endothelial cells and containing a deeply staining material. Between these spaces are many small tightly packed endothelial cells which often contain a single centrally placed nucleus. The cells are uniform in size and are deeply stained. In this case, the patient died of metastasis.

TREATMENT

Irradiation has thus far proved to be the most valuable method of treating primary hemangioma of bone. Complete cures have been reported in a number of instances. Case 1 of our series did not respond to irradiation. The value of curettement is questionable. Resection of bone has been reported in several cases and has proved to be an absolute means of cure. Further observations will be necessary before any specific recommendations can be offered.

FIG. 10

Case 3. P. N. 54290. Angioblastoma of bone. (Low magnification.)

CASE REPORTS

CASE 1. P. N. 52672, a white female, aged eight, fractured her left arm on November 8, 1933. The arm was in plaster splints for six weeks, and one week after the removal of the splints, was fractured again. (The roentgenographic findings have already been described.) An exploratory operation was performed in January 1934 by Dr. George E. Bennett. The area was irradiated with deep x-ray. The pathological diagnosis was capillary hemangioma. The lesion slowly progressed, and the arm was again fractured in 1935, which resulted in a second operation. The clinical course was uneventful until September 1937, at which time the patient sustained another fracture of the humerus below the previous site. A bone graft was implanted. Roentgenographic examinations, taken at frequent intervals beginning with the original injury in 1933, showed a steady progression of the lesion. (See Figure 2.) The condition is still uncured.

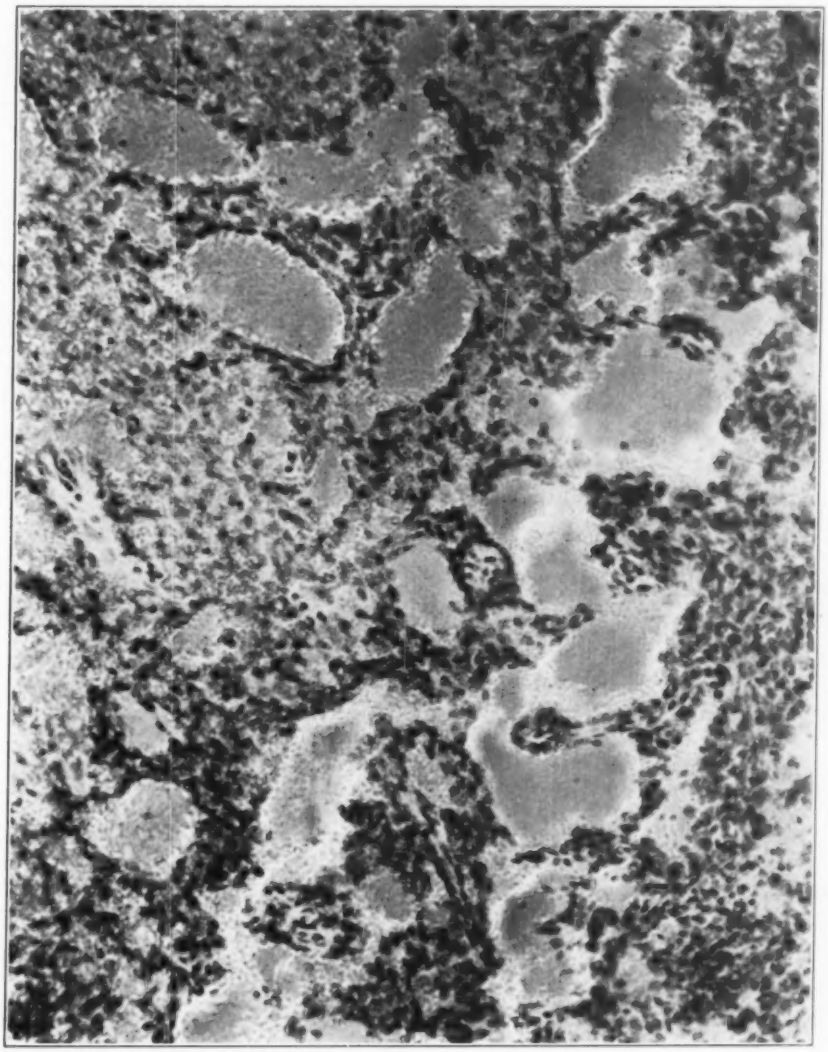

FIG. 11

Case 4. P. N. 37954. Angiosarcoma of bone. (Low magnification.)

CASE 2. P. N. 57674, a white male, aged ten, sustained a crushing injury to the left forearm two years previous to examination. The wrist had been placed in a splint for several weeks. Swelling, which began at the time of injury, had persisted and had become worse some weeks prior to the examination. Pain and disability had increased. (For details of the roentgenographic findings see previous description.) The lower end of the left radius was resected, leaving the epiphysis intact. A bone graft was inserted. The pathological diagnosis was cavernous hemangioma. No recurrence followed, and the patient has a fairly good, functioning wrist.

CASE 3. P. N. 54290, a white male, aged eleven, injured the right arm in May 1931. The clinical findings were those of a pathological fracture. The roentgenogram showed a fracture through a cystic lesion. The lesion was curetted, and a bone graft was inserted. The arm was again injured in July 1934. A biopsy was performed, and the diagnosis was sarcoma. The surgeon resected the right arm at the shoulder joint. A description of the gross specimen has been given. The final pathological diagnosis was angioblastoma. Our last follow-up examination in 1937 showed the patient to be well.

CASE 4. P. N. 37954, a white female, aged twenty, was admitted to the St. Luke's Hospital in July 1921, complaining of a mass over her ankle of ten months' duration. Examination revealed a cystic mass below the external malleolus and attached to the deep structures. The tumor was resected. The mass recurred five years later. Roentgenographic examination of the os calcis showed bone changes. An exploratory operation revealed an angiomatous tumor arising from the periosteum and involving the os calcis. Curettement of the os calcis was performed. The patient ultimately died of metastasis.

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BONE BLOCK FOR PAINFUL HIPS *

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The purpose of this paper is to present our experience in the treatment of a common condition, that of painful hips, by a new procedure or, rather, a new application of a method already used in other parts of the body. We cannot say that we are reporting end results, although we have used this method for over six years, as the final results cannot be estimated for many more years to come. We are simply giving the information available at this time as to the results of this operation.

In March 1927, an extra-articular fusion was attempted in a case of tuberculosis of the hip, and failure resulted. The bone graft united to the side of the ilium, but failed to fuse on the trochanteric side, so that the bone graft acted as a block against the femur. The result was a movable hip with a large block of bone attached to the ilium on one side and impinging on the greater trochanter on the other. When the patient was allowed to walk, we were surprised to find that the pain had been relieved. Although the hip never fused, the pain was apparently permanently relieved. The last examination of the patient in October 1937, ten years after the operation, showed that he had a fair amount of painless motion.

We tried to explain the relief of symptoms by the fact that the bone graft was acting as a block against the trochanter, whereby some of the weight was carried on the greater trochanter through this bone. We began to wonder whether or not this operation, if done purposely instead of accidentally, would be successful in relieving pain in cases of painful tuberculous hip joints, without apparent activity, but we have never had the courage to do it for tuberculosis until recently.

We recalled this accidental experience in the spring of 1932 when a young woman, nineteen years of age, was admitted to our Service at the Kings County Hospital with a painful hip. The pain was so severe that the patient had been confined to bed for several weeks before being admitted. Roentgenographic examination of the hip revealed that she had a probable old untreated epiphyseal separation with the usual consequent hip deformity. Our problem was to relieve the pain without causing loss of use of the hip joint by an ankylosing operation, as we realized that an arthrodesis of the joint promised the only sure relief of symptoms. However, this seemed a radical procedure and meant a permanent deformity in a very young girl.

We decided to do purposely for this patient that which in other cases had occurred accidentally, so that we might take some of the weight from the joint proper and transfer it to the lower neck of the femur. In this way we might possibly relieve the pain. We also felt that if the operation

* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Los Angeles, California, January 20, 1938.

failed we could always fuse the joint to give relief. We have followed this case now for nearly six years and so far the patient has had no return of symptoms.

Encouraged by this result, we did a similar procedure on a boy suffering from an old apparently healed tuberculous lesion of the hip. In this case, the pain was probably due to poor mechanics in the joint. This patient was also relieved. We then felt that we might extend our indications to include other conditions with distortion and consequent poor hip-joint mechanics, particularly in cases of osteo-arthritis with severe pain in the hip, but with a good range of flexion and extension of the joint. However, in the arthritic cases with very little or no motion at the hip, we felt that a fusion was to be preferred to the bone block. In bilateral arthritis or tuberculosis of the hip with some motion present, the bone-block would be especially indicated, to avoid the severe disability of two stiff hips.

We have now performed the operation in seventeen cases: four cases of slipped epiphysis; three cases of congenital dislocation of the hip, where it was done instead of a shelf operation; four cases of tuberculosis; and six cases of hypertrophic arthritis. Not all of the patients have been completely relieved of pain, but, as a whole, the results have seemed very satisfactory to the patients and to ourselves. For practical purposes we may say that the operation has been done for arthritis of the hip, regardless of what may have caused the arthritis, as it is impossible in some cases to determine the exact cause. For example, it is very difficult in adult life to determine whether a distorted hip joint is the result of Perthes' disease, slipped epiphysis, trauma, or low-grade infection in childhood. One might think that with a good history the diagnosis should be simple, but many of these patients have a hazy memory of disability either in childhood or in early youth. In future cases of congenital dislocation of the hip, we shall probably not continue to have the graft act as a block, but we shall use the same type of graft as a shelf.

The rationale is difficult to explain, but it seems to us that the bone block apparently takes on some of the weight in walking, and thus relieves the weight-bearing joint surfaces. This theory is supported by the fact that the graft is essentially parallel with the neck of the femur, and it takes up the stress and strain of the neck, as evidenced by the growth of the transplant as time goes on. We feel that the graft would absorb if no stress were placed on it. This happened in only one of the cases, which was a failure. Our belief in this theory is further strengthened by the fact that in another case, where the graft fractured near the iliac attachment, union followed, and the transplanted bone has continued to grow and is now bigger than the original transplant.

All of these patients develop an adduction and flexion deformity. To us, this is an indication that abduction produces pain, and nature attempts to relieve this pain by bringing the leg into adduction by muscle spasm. This is a protective mechanism. The operation helps nature to

do this. The bone block limits abduction beyond a straight line and if the block is not sufficiently long to do so, the operation will be a failure, unless there is considerable shortening of the limb, in which case the block and the femur are brought close together when the pelvis tilts down toward the shorter limb on walking. Otherwise, no weight will be transmitted through the graft if the leg can go into abduction, although one of our patients has been completely relieved in spite of the fact that she has some abduction. Perhaps this explains why some of our patients were not completely relieved, as the grafts were not long enough. If the block is long enough to transmit the weight, it will grow in size as time goes on. If it is not long enough, it will atrophy. This happened in two of our cases. In our later efforts we have made sure that the graft is sufficiently long.

Thirteen of the seventeen patients were operated upon from two to five years ago. Only the cases of these thirteen will be described. Of these, eight have been relieved of pain; three have improved; one has not improved; and in one case the final result is unknown as we were unable to locate the patient for further check-up two years following the operation. However, she was seen about a year and a half after operation, at which time she walked with an excellent gait and was being treated with vaccines for joint pain in the hands, the wrists, the shoulders, and the neck.

Our results may be classified as "good", "fair", and "poor". By good, we mean that the pain has been relieved; by fair, the pain has been partially relieved; by poor, the pain persists as before operation. According to this classification, we have obtained good results in eight cases, fair results in three cases, poor results in one case, and the result is unknown in one.

TECHNIQUE OF OPERATION

The hip area and the side of the ilium are exposed by a modified Smith-Petersen incision, bringing the upper arm of the incision well back along the crest of the ilium to expose the crest and the upper portion of the side of the ilium to permit the removal of a good-sized graft. This graft is taken in one of two directions, depending on the individual case. If there is no protrusion at the outer junction of the head and the acetabulum, a straight graft is used to stretch across the joint between the ilium and the trochanteric fossa or the greater trochanter. In some cases there is a mass of bone at the acetabulofemoral junction, so that a straight graft will not reach between these points. In that case, a curved graft is necessary. The straight graft is taken vertically on the side of the ilium, including half the crest and the outer table of the ilium, and is sufficiently long to reach between the points of contact which have been previously determined. The graft should be about one and a half inches wide (Fig. 1). If the curved graft is necessary, it is taken along the natural curve of the ilium, starting just behind the anterosuperior spine and going backward until the desired length can be removed (Fig. 2). When measuring

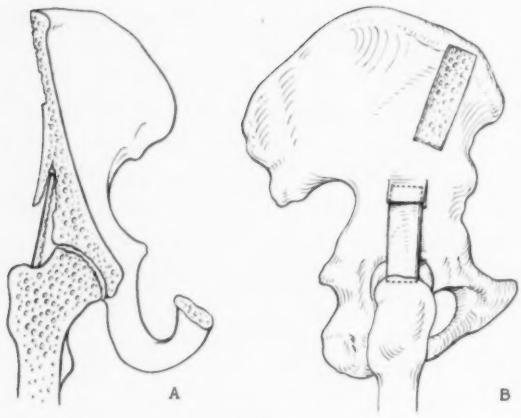

FIG. 1

Diagrammatic drawing showing the technique of the operation when a straight graft is used.

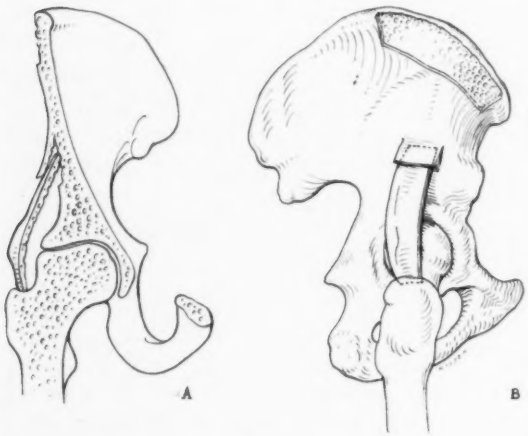

FIG. 2

Diagrammatic drawing showing the technique of the operation when a curved graft is used.

for the length of the graft, the surgeon should adduct the thigh, so that after the upper end of the graft is placed in a slot on the side of the ilium, the lower end is jammed tightly against the trochanter or the trochanteric fossa, as the thigh is abducted to the straight or neutral position. One must be sure not to place it in the slightest abduction. As the thigh is brought from the adduction to the neutral position, the graft is firmly pushed into the ilium. No sutures are necessary to hold the graft. A hip spica is then applied from the nipple line to the ankle. This is changed to a short spica after six or eight weeks, and the patient is allowed to walk with crutches. Complete weight-bearing is permitted as soon as roentgenographic examination shows union of the graft to the ilium, which is usually seen in from ten to twelve weeks.

Brief case histories of the patients, two or more years after operation, follow.

CASE REPORTS

CASE 1. J. D., a white male, aged seventeen, in January 1926, applied for treatment for tuberculosis of the left hip at the Long Island College Hospital. He was given conservative treatment with traction and a plaster spica until March 4, 1927, when an extra-articular fusion of the hip was performed, followed by immobilization in plaster for six months. At the end of that time, roentgenograms showed that the upper end of the graft had united with the ilium, but the lower end had not united with the greater trochanter; good painless motion was present in flexion and in extension of the hip. As long as the patient had no subjective symptoms referable to the hip, he was permitted to

walk without any support. We decided that if pain should return a refusion operation was to be done.

We continued to watch the patient until 1933, during which time there was no recurrence of pain. The patient was again examined in October 1937, when we noted that he still had motion in flexion and extension and was able to walk without pain.

CASE 2. C. F., a white female, aged nineteen, unmarried, was admitted to the Kings County Hospital on April 9, 1932, complaining of pain in the right hip, which had begun seven months before admission. The pain had gradually increased in severity until about two weeks prior to admission, when she had been completely disabled and was forced to stay in bed for relief of pain.

A diagnosis of probable old slipped epiphysis was made, and a bone-block operation was performed on April 21, 1932. The patient was discharged on August 21, 1932. She was last seen on December 18, 1937, when she stated that she had had no pain since the operation. The result was good.

CASE 3. T. T., a white female, nine years of age, was admitted to the Long Island College Hospital on April 21, 1933, complaining of pain in the left hip and limping. She gave a history of having been treated for tuberculosis of the hip joint since the age of two. The relevant physical findings were that she had some draining sinuses from some submaxillary glands, and she walked with a marked limp on the left side with the foot in marked equinus. The left extremity showed two and a quarter inches of shortening. The greater trochanter was about two and a half inches above Nélaton's line. All motions of the hip were markedly restricted, except for flexion and extension in which there was a fair amount of motion.

Roentgenographic examination showed complete destruction of the head of the femur and almost complete destruction of the neck, and marked destruction of the acetabulum and of the adjoining ilium.

A diagnosis of tuberculosis of the joint was made, and a fusion was advised. An arthrodesis of the joint was done on April 25, 1933, by applying a large bone graft across the hip joint between the side of the ilium and the greater trochanter. The patient was discharged on June 21, 1933, wearing a plaster spica, with instructions to return to the Out-Patient Department for observation.

Roentgenographic examination on August 30, 1933, showed the graft to be in good position and apparently uniting. The cast was changed on September 25, 1933, and again on December 15, 1933. Roentgenograms again showed that the graft was in good position and apparently alive. The cast was removed on February 14, 1934, and a caliper brace was applied.

Notes made in the Out-Patient Department on July 23, 1934, state that the patient was walking with a caliper brace, apparently comfortable, and with a limp which seemed to be due to the shortening, but with a "rather remarkable range of motion in *all* directions.

FIG. 3

Case 2. First case in which a bone block was done intentionally. This was a case of an old slipped epiphysis where a straight graft was used at operation on April 21, 1932. This roentgenogram was taken three years after operation.

FIG. 4

Case 3. An accidental bone graft for tuberculosis of the left hip, following an attempt at fusion on April 25, 1933. This roentgenogram was taken about two years after operation.

Clinically she seems well; no loss of appetite; no pain." A roentgenogram taken at this time revealed that the graft had united firmly to the ilium, but not to the trochanter; thus the graft was acting as a block.

The patient was again admitted to the Hospital on January 27, 1936, this time for cervical glands and Pott's disease. At this time there was a painless and movable hip, but the shortening had increased to three and a half inches.

CASE 4. E. S., a white female, aged eleven, was admitted to the St. Giles Hospital on April 9, 1934, complaining of pain in the left hip on walking and of limping for the past few months. A diagnosis of congenital dislocation of the hip had been made and a closed operation had been performed at the Israel Zion Hospital, followed by immobilization in a plaster-of-Paris cast for sixteen months.

Roentgenographic examination showed a very shallow acetabulum. The head of the femur was almost entirely out of the acetabulum A diagnosis of congenital dislocation of the hip was made and a bone-block operation was performed in April 1934.

The patient was last seen on December 18, 1937, when abduction was equal but restricted on both sides. Five-eighths of an inch of shortening was present, but there was no telescoping, and the patient did not complain of pain on walking. The graft acted as a shelf.

CASE 5. J. W., a colored male, eighteen years of age, was admitted to the Kings County Hospital on July 2, 1934, complaining of pain in the left lower extremity and limping. Pain had been present for two months prior to admission. The patient gave a history of having had a slight limp since childhood.

Roentgenographic examination showed an old destructive lesion of the hip. The head of the femur was completely absorbed. A diagnosis of probable old tuberculosis of the hip was made. There was no evidence of activity. A bone-block operation was performed on July 26, 1934, and the patient was discharged on October 29, 1934.

The patient was last seen on February 8, 1935, at which time motion in flexion and in extension was good. He still complained of slight pain, but stated that he was satisfied with the result and would go through the same operation again if necessary.

CASE 6. I. K., a colored female, twenty-four years of age, unmarried, was admitted to the Kings County Hospital on March 26, 1935, with a history of having had trouble with the right hip since the age of nine. In 1934, the patient had experienced pain in the

hip on weight-bearing, which had persisted to the date of admission. The pain had been relieved by rest.

Roentgenographic examination revealed complete absorption of the head of the femur and marked absorption of the acetabulum, but there was no apparent active disease. A diagnosis of probable tuberculosis was made, and a bone-block operation was performed on April 4, 1935. The patient was discharged on July 11, 1935.

She was last seen on December 18, 1937, when the hip was found to be stable. Abduction was limited. She was able to walk any distance without pain, including going up and down stairs.

CASE 7. L. R., a white female, aged eleven, was admitted to the Long Island College Hospital on April 5, 1935, complaining of pain in the left hip on walking. She gave a history of bilateral congenital dislocation of the hip. Both dislocations had been reduced, but the right had recurred. A bone-block operation was performed on April 9, 1935, and the patient was discharged on April 16, 1935.

She was last seen on November 22, 1937, when she walked with a considerable limp, but with no Trendelenberg symptom. The limp was due to seven-eighths of an inch of shortening. There was no pain on walking.

CASE 8. E. N., a white male, twenty-five years of age, was admitted to the Long Island College Hospital on June 26, 1935, complaining of intermittent pain in the left hip of seven or eight years' duration.

Roentgenographic examination showed marked destruction of the head of the femur and of the acetabulum of the left hip. The head was enlarged and flattened. The neck was broad and short. A diagnosis of probable old slipped epiphysis was made, and a bone-block operation was performed on July 23, 1935. The patient was discharged on October 30, 1935.

FIG. 5

Case 6. A straight graft was used for tuberculosis of the hip at operation on April 4, 1935. This roentgenogram was taken one year after operation.

The patient was not seen again, but in November 1937 his doctor stated that the patient had been relieved of pain and was walking around comfortably.

CASE 9. F. P., a white female, thirty-two years of age, was admitted to the Kings County Hospital on August 13, 1935, complaining of pain in the left hip of three years' duration, which was aggravated on standing and on walking and was relieved by rest.

Roentgenographic examination showed hypertrophic arthritis of the left hip. A bone-block operation was performed on August 22, 1935, and the patient was discharged on September 29, 1935.

The patient was last seen on December 18, 1937, when she stated that before the operation she had been unable to walk more than one or two blocks without having severe pain in the hip, but she was then able to walk indefinitely and to work all day without any pain. Abduction was completely limited.

CASE 10. A. G., a white female, aged forty-eight, was admitted to the Kings County Hospital on August 19, 1935, complaining of pain in the left hip of fifteen years' duration. The pain had increased to the extent that just before admission it was almost impossible for her to walk. She gave a history of having fallen twenty years previously. A shelf operation had been performed elsewhere on this hip, without success. The present pain was aggravated by walking, but was relieved by rest. It was not relieved by physiotherapy.

FIG. 6

Case 9. A curved graft was used in a bone-block operation on August 22, 1935, for hypertrophic arthritis of the hip. The pain was completely relieved. The patient does all her own housework. This roentgenogram was taken one and a half years after operation.

Roentgenographic examination showed the upper outer aspect of the head of the femur to be outside of the acetabulum. The head was flattened and mushroomed; the neck was broadened. A diagnosis of osteo-arthritis of the left hip was made, and a bone-block operation was performed on August 22, 1935. The patient was discharged on October 8, 1935.

The patient was last seen on December 18, 1937, when she stated that, although the pain had not completely disappeared, it was less than it had been prior to the operation, and she was able to walk longer distances than before. She also stated that her condition was still improving.

CASE 11. R. D., a white female, aged thirty-one, was admitted to the Long Island College Hospital on July 18, 1935, because of a painful left hip. She gave a history of having had trouble in that hip at the age of twelve, when it was treated with plaster spicas for six months. There had been relief of pain for four

FIG. 7

Case 10. This roentgenogram shows some absorption of the lower end of the graft. The patient had had a previous shelf operation for relief of pain, which failed. A bone-block operation was performed on August 22, 1935. The pain was not completely relieved, but the patient is well satisfied with the result. She can walk about ten blocks before pain develops. This roentgenogram was taken two years after operation.

years; then it had recurred, and another spica had been applied for six weeks. This had given relief, and she had been well for the following fifteen years, up to the time of her present admission.

A diagnosis of old epiphyseal separation of the left hip was made, and a plaster spica was applied on July 27, 1935. The patient was discharged to the Out-Patient Department on July 29, 1935.

She was readmitted on October 2, 1935, as immobilization in plaster gave her only temporary relief. When the plaster was removed, the pain recurred.

FIG. 8

Case 11. A bone-block operation was done on October 17, 1935. The roentgenogram shows that the lower end of the graft has been absorbed. This case was a complete failure. The patient had no relief of symptoms. The roentgenogram was taken two years after operation.

FIG. 9

Case 15. Roentgenogram showing accidental fracture of the graft. This case is not described in the text.

FIG. 10

Case 15. The fracture has healed and the graft has increased in size. This roentgenogram was taken seven months after operation. The fact that the graft has united and has continued to live indicates that some stress is being placed upon it.

On the second admission, a bone-block operation was performed on October 17, 1935. The cast was removed on December 27, 1935, and roentgenographic examination at this time showed an apparently solid block. On December 31, 1935, the patient was allowed to walk with a support, and she was discharged on January 16, 1936.

When last examined, on September 21, 1937, she complained of pain in the hip when lying or sitting down. This pain was accompanied by marked stiffness, but after walking a short distance she was able to continue walking for about a mile without any recurrence of pain.

We have classified this case as a complete failure, although the pain is of a different character than it was before the operation. It is more that of a rheumatoid arthritis, which is strengthened by the fact that she now has pain in other joints for which her tonsils were removed in July 1937, to eliminate a possible focus of infection. The pain before operation was apparently continuous when walking, while the present pain occurs when the joint is inactive. The pain on walking has disappeared.

CASE 12. I. K., a white female, aged thirty-six, was admitted to the Kings County Hospital on November 1, 1935, complaining of pain in the right hip of ten years' duration, progressive in character. She gave a history of having injured the right hip at the age of seven.

Roentgenographic examination showed marked destruction of the hip joint with mushrooming and broadening of the head of the femur and shortening of the neck. The acetabulum was enlarged, with hypertrophic changes at the margins of the acetabulum. A diagnosis either of an old slipped epiphysis or of an old Perthes' disease was made. It was very difficult to tell which was the cause of the condition, and a bone-block operation was performed on November 14, 1935. The patient was discharged to the Out-Patient Department on December 28, 1935.

She was last seen in the Out-Patient Department on May 3, 1937, when she walked with a slight limp, although her gait was excellent. She was being treated with streptococcus vaccines for pain in the joints of the hands, the wrists, the shoulders, and the neck.

CASE 13. J. H., a white male, aged fifty-five, was admitted to the Kings County Hospital on March 25, 1936, complaining of pain in the right hip of two years' duration. The pain had increased in severity, so that just prior to admission the patient had been able to walk only a very short distance and had had to rest frequently to get relief. His past history was negative except for gonorrhoea thirty years previously.

A diagnosis of osteo-arthritis of the right hip was made, and a bone-block operation was performed on April 2, 1936. The patient was discharged on June 14, 1936.

This patient was last examined on September 21, 1937. He was then able to walk without pain and without any limp.

CONCLUSIONS

Seventeen patients have been operated upon for various painful lesions of the hip, characterized by arthritic joint deformity with consequent poor mechanical function of that joint.

The majority of the patients have been either partially or completely relieved of pain. Four cases are too recent to warrant a final report; one is a complete failure.

It is our opinion that the pain is relieved because the graft takes on some of the weight in walking, producing what we might call an accessory hip joint, or because the abduction is limited by the bone block and thus impingement of the capsule is prevented.

THE HEALING OF JOINT FRACTURES

A Clinical and Experimental Study* †

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The question in regard to the ability of articular cartilage to regenerate after injury has long been a subject of controversy. Its answer would contribute greatly both to an understanding of symptomatology and to the rational treatment of fractures into joints. The reason for the uncertainty in this matter lies in the difficulty of obtaining suitable specimens for microscopic study. The surgeon hesitates to excise a portion of a fractured joint merely to satisfy his scientific curiosity, and the opportunity to inspect a joint several months after fracture does not often occur. Animal experiments, which permit the observation of the various stages of healing, have given conflicting results, depending on the species of the animals used and the type of injury inflicted. The present study of surgical specimens collected over a period of eight years has been supplemented with experiments on rabbits in which injuries to the articular cartilage were produced by the closed method and at operation.

To review adequately the steps in the development of our knowledge of the response of cartilage to injury would greatly exceed the bounds

TABLE I

Closed Experimental Fractures

Rabbit No.	Joint	Observation Period (*Days*)	Appearance of Microscopic Sections
142	Elbow	4	Defect in cartilage filled with blood clot.
146	Elbow	7	Degeneration of comminuted cartilage.
146	Knee	7	No repair of fissure in cartilage.
145	Elbow	14	Intra-articular adhesion between humerus and ulna.
141	Elbow	16	Defect in cartilage filled with fibrous connective tissue.
141	Knee	16	Chipping of cartilage invaded by fibrous tissue.
138	Ankle	23	Degeneration of cartilage (traumatic arthritis).
143	Ankle	31	Defect in cartilage filled with embryonic connective tissue.
143	Elbow	31	Defect filled with atypical cartilage (? regeneration).
139	Elbow	37	Large loose fragment of cartilage (osteochondritis dissecans).
137	Elbow	44	Transition from connective tissue to new cartilage.

* This work has been conducted under a grant from the Christine Breon Fund for Medical Research of the University of California.

† Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Los Angeles, California, January 20, 1938.

FIG. 1

Elbow of Rabbit 139, thirty-seven days after closed fracture. (Magnification × 35.)
A: Loose piece of cartilage in joint.
B: Bone (head of radius).
C: Normal cartilage on head of radius.
D: Defect filled with fibrous tissue.

of this paper. An excellent historical résumé has been given by Shands, who also has described the effects of the production of defects in the articular cartilages of the knees of dogs. Regenerative changes pass through successive stages of fibrin, granulation tissue, and connective tissue, which is converted into fibrocartilage and finally into new hyaline cartilage. In a similar manner, Key produced a traumatic arthritis in the knees of adult rabbits by the removal of a small area of articular cartilage. The defects were healed by the metaplasia of callus into hyaline cartilage, or by the growth of connective tissue. Haas observed the regeneration of the costal cartilages of rabbits which occurred by a direct proliferation of all the layers of the perichondrium beneath the outer fibrous tissue. A series of studies of articular injuries leading to chronic arthritis have been reported by Bennett and Bauer. They pro-

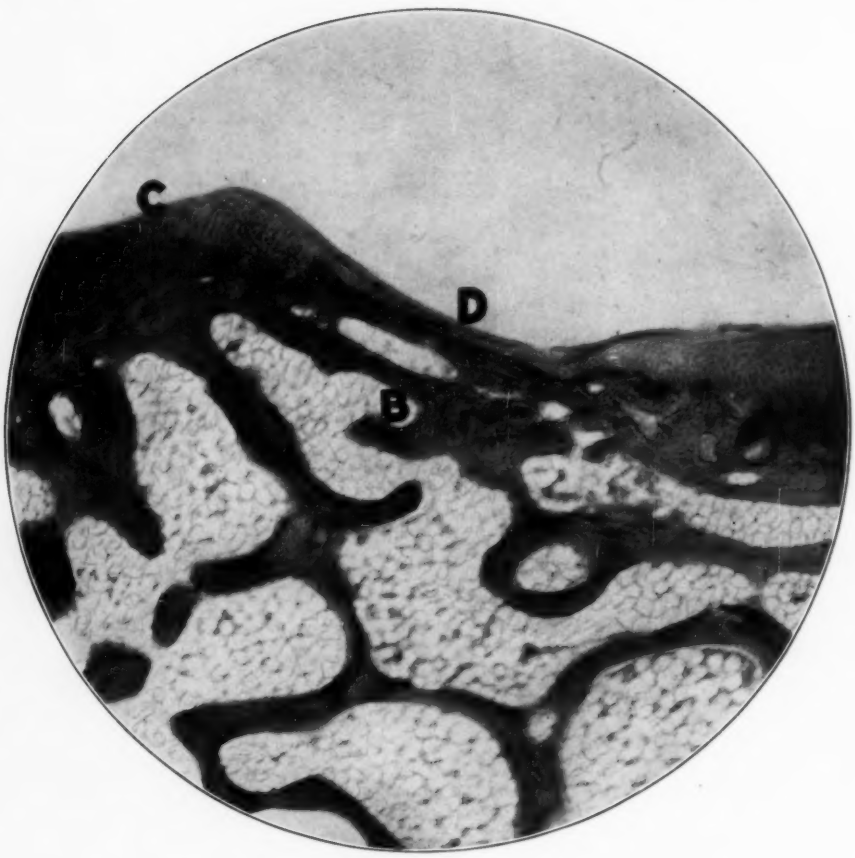

FIG. 2

Elbow of Rabbit 182, thirty-two days after open fracture. (Magnification × 35.)
B: Bone (condyle of humerus).
C: Normal cartilage.
D: Defect in cartilage filled with fibrous tissue.

duced defects in the cartilage of the patellar surfaces of the femora of dogs. Microscopic observations, made by sacrificing the animals at different periods from four to twenty-eight weeks after the operation, showed only infrequent and incomplete regeneration of the hyaline cartilage. The author has been unable to find any reports dealing with the healing of articular cartilage following fractures in man.

METHODS AND RESULTS

In the interest of brevity and clarity, it seems best to outline the experiments and the clinical material to be presented, to tabulate the observations made, and to show a few typical specimens. The experiments fall into three groups, and were made on half-grown and adult rabbits. The clinical material comprises a fourth group. Photomicrographs are shown to illustrate the various stages of healing.

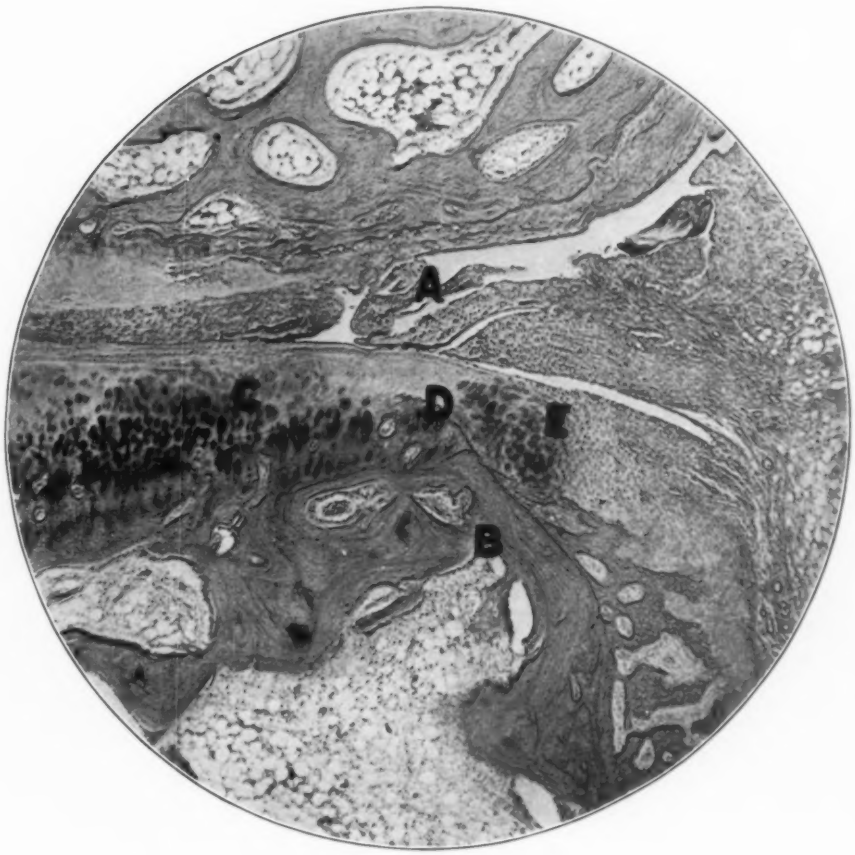

FIG. 3

Elbow of Rabbit 198, fifty-six days after open fracture. Immobilized for six weeks after fracture. (Magnification × 80.)

A: Adhesion across joint space.
B: Bone (condyle of humerus).
C: Normal cartilage.
D: Edge of defect in cartilage.
E: Metaplasia of fibrous tissue into cartilage.

Group A

Fractures were produced in the joints of rabbits by allowing a weight to fall on the limbs which were stretched over a block. The character of the fractures was determined by roentgenographic examination, and the animals were killed at various periods after the fractures. Microscopic sections of the eleven specimens, which included the entire joint, were prepared by the celloidin method and were stained with hematoxylin and eosin. A list of experiments and results is given in Table I.

Group B

A wedge-shaped defect, measuring three millimeters in width and extending into the subchondral bone, was made in the articular surface

TABLE II

OPEN ELBOW FRACTURES TREATED BY CAST

Rabbit No.	Observation Period (*Days*)	Appearance of Microscopic Sections
185	7	Early callus restoring bone; no regeneration of cartilage.
192	14	Adhesion across joint; early regeneration of bone, but none of cartilage.
195	29	Adhesion across joint; regeneration of bone, but none of cartilage.
196	41	Adhesion; transition from cartilage into fibrous tissue filling defect.
198	56	Adhesion; nest of cartilage cells formed from connective-tissue cells in defect.
209	70	Adhesion; degeneration of cartilage at edge of defect; traumatic arthritis.
210	72	Thin layer of new bone covered with synovia; no regeneration of cartilage.
211	89	Adhesion; fibrous tissue replacing cartilage on surface of defect.
212	108	Fibrous tissue in defect being transformed into cartillage.

of the lower end of the humerus at operation. The nine limbs included in this group were immobilized for about six weeks, or until the end of the

TABLE III

OPEN ELBOW FRACTURES TREATED WITHOUT CAST

Rabbit No.	Observation Period (*Days*)	Appearance of Microscopic Sections
180	7	Early callus; fibrin in defect; no repair of cartilage.
213	16	Infected; adhesion across joint, plasma cells in cartilage defect.
214	16	Decolorized cartilage at edge of defect, with no repair.
178	18	Infected; defect filled with chronic granulation tissue; no repair.
177	21	No repair of punched-out area of cartilage.
179	22	Small defect with fibrous tissue lining base, but no repair of cartilage.
181	26	Floor of defect formed of dead bone; no repair of cartilage.
182	32	Floor of defect composed of thin layer of fibrous tissue on newly formed bone.
176	39	Defect in cartilage repaired with cartilage having no basal layer.
215	56	New bone covered with fibrous tissue on surface of which is synovia.
216	73	No regeneration of bone or cartilage of defect.
183	96	Atypical cartilage in defect; cells in transition from osteoblasts to cartilage.

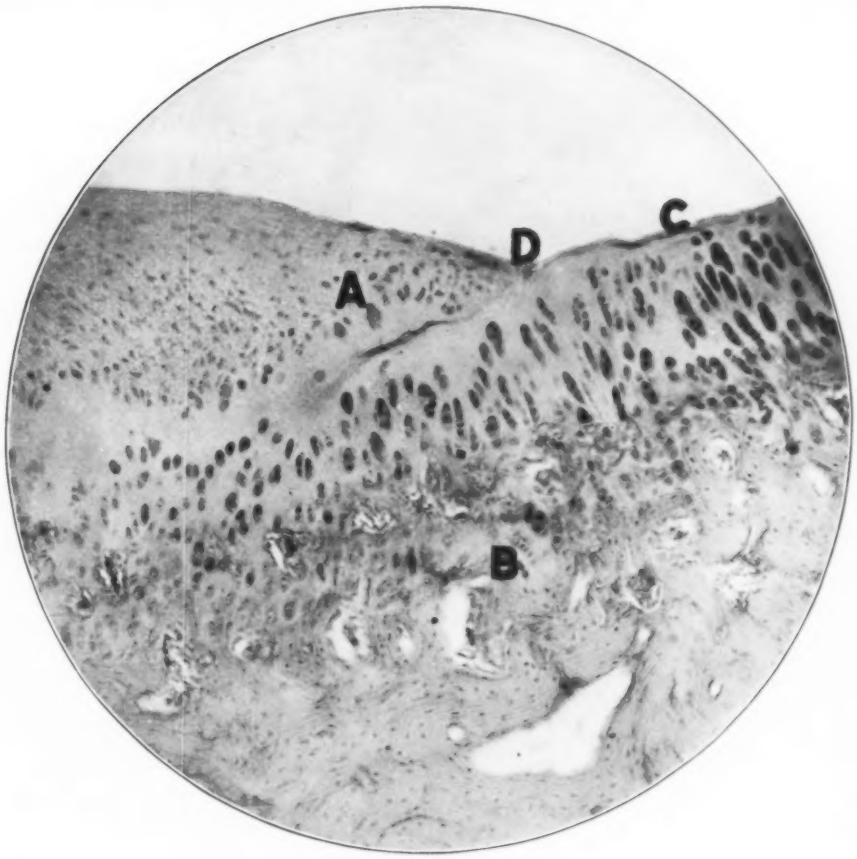

FIG. 4

Elbow of Rabbit 212, 108 days after open fracture. Immobilized for six weeks after fracture. (Magnification × 100.)

A: Fibrous tissue, showing metaplasia into hyaline cartilage.
B: Subchondral bone.
C: Normal cartilage.
D: Edge of defect in cartilage.

experiment, by means of a plaster cast. The entire joint was sectioned and was studied both for the repair of the cartilage and for the development of intra-articular adhesions. The results are shown in Table II.

Group C

In the twelve experiments of this group, the procedure was the same as in the previous group, but no form of immobilization was used. The results are summarized in Table III.

Group D

The clinical material consisted of twenty-eight specimens of cartilage and subchondral bone which were removed from patients at operation after fractures extending through the articular cartilage. These specimens had been collected over a period of eight years with the present

TABLE IV

SUMMARY OF TWENTY-EIGHT CLINICAL CASES

Case No.	Bone	Duration of Injury	Appearance of Microscopic Sections
1	Head of radius	5 days	Stripping away of hyaline cartilage; fissure.
2	Head of radius	4 weeks	No healing of fissure through hyaline cartilage.
3	Head of radius	9 weeks	Roughening of surface of hyaline cartilage; no regeneration.
4	Head of radius	6 months	Replacement of fractured edge of cartilage by fibrous tissue.
5	Head of radius	1 year	No regeneration of several large fissures through cartilage.
6	Head of radius	6 years	Eburnation of bone at base of cartilage defects.
7	Carpal navicular	1 hour	Chipping of superficial layers of hyaline cartilage.
8	Carpal navicular	7 months	Fibrous union of bone; no union or repair of cartilage.
9	Carpal navicular	1 year	Unhealed fissure in hyaline cartilage with fibrous edge.
10	Carpal navicular	18 months	Devitalization of entire fragment of bone and cartilage; no repair.
11	Carpal navicular	28 years	Degeneration of cartilage; metaplasia from connective tissue to cartilage.
12	Astragalus	8 days	Death of nuclei of cartilage and bone; no regeneration.
13	Astragalus	2 weeks	Fractured edge of cartilage and bone; no regeneration.
14	Astragalus	67 days	Hyaline cartilage partly torn off at calcified zone; no repair.
15	Calcaneocuboid	6 months	Cartilage invaded and covered by connective tissue from bone.
16	Calcaneocuboid	11 months	After arthrodesis. Mixture of hyaline cartilage and fibrous tissue.
17	Carpal lunate	4 months	Kienböck's disease. Deep fissures in cartilage; fibrous degeneration.
18	Carpal lunate	16 months	Kienböck's disease. Desquamation of surface of cartilage; no repair.
19	Carpal lunate	Uncertain	Kienböck's disease. Irregular new cartilage under old fissured cartilage.
20	Carpal lunate	Uncertain	Kienböck's disease. Degenerating fringes of hyaline cartilage.
21	Femoral condyle	20 days	Degenerating cartilage with fissure on surface; no repair.
22	Femoral condyle	10 weeks	Osteochondritis dissecans. Fissure in cartilage; no repair.
23	Femoral condyle	3 years	Osteochondritis dissecans. No repair of fissure in cartilage.
24	Femoral condyle	5 years	Charcot's joint. Areas of cartilage replaced by fibrous tissue.
25	Patella	20 days	Separation of cartilage from bone; fissure on surface; no repair.
26	Head of humerus	10 weeks	Fissure through cartilage and bone; faint nuclei; no repair.
27	Head of femur	3 months	Bone viable; fibrous tissue between bone and cartilage; no repair.
28	Head of ulna	13 months	Extensive degeneration of hyaline cartilage; no repair.

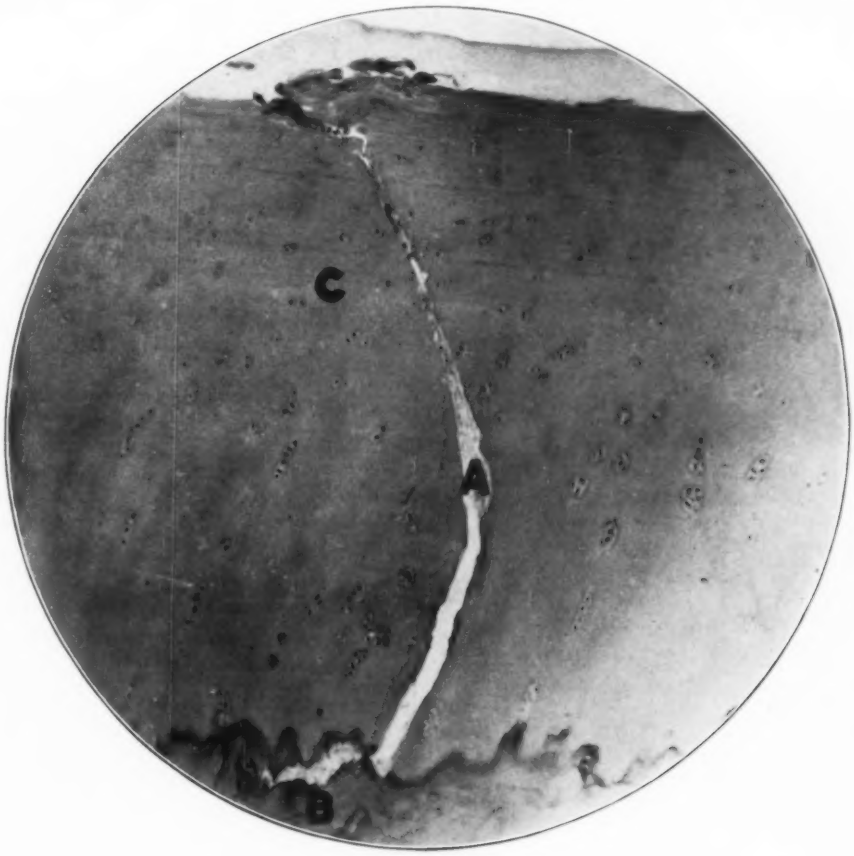

FIG. 5

Head of radius of Case 2, four weeks after fracture. (Magnification × 100.)
A: Fissure extending through hyaline cartilage, with no attempt at repair.
B: Subchondral bone into which fissure extends.
C: Hyaline cartilage.

problem in mind. A description of the microscopic sections is given in Table IV.

DISCUSSION

The results of the various studies here reported may be discussed briefly. The observation periods in eleven closed fractures of certain joints of rabbits ranged from four days to forty-four days. After two weeks, the defects in the articular cartilage were filled by an invasion of fibrous connective tissue from the subchondral bone. Beginning about one month after injury, traces of fibrocartilage appeared in the connective tissue. The preexisting articular cartilage played no part in this regeneration.

Two groups of experiments were performed by the removal of a wedge of cartilage and bone from the lower end of the humerus. In the twelve rabbits without immobilization, the observation period ranged

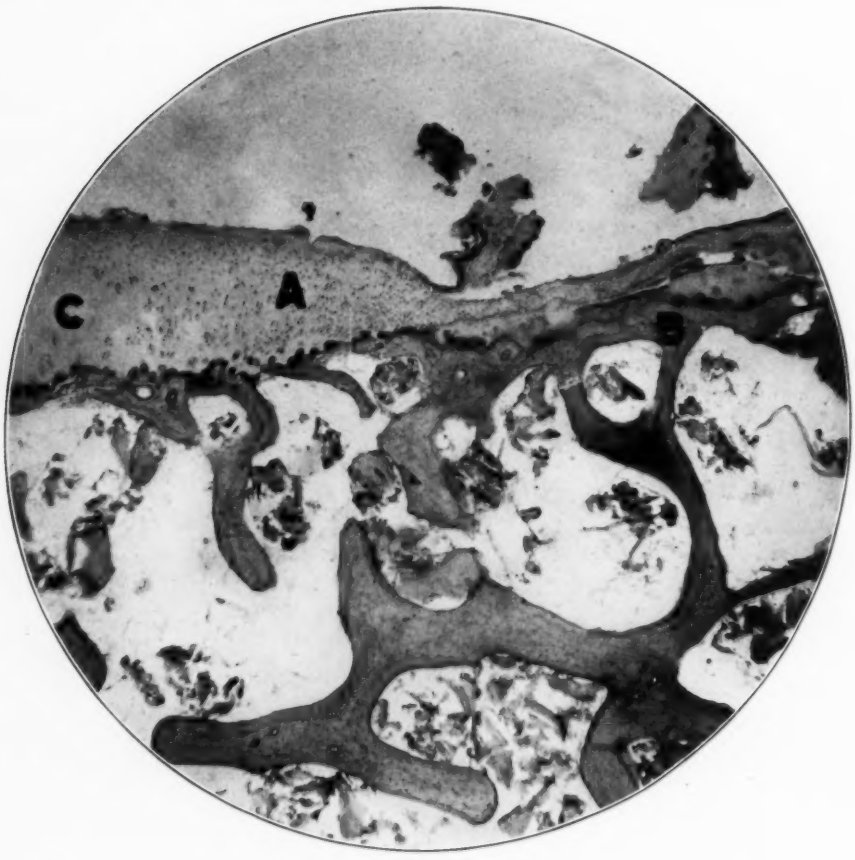

FIG. 6

Head of radius of Case 6, six years after fracture. (Magnification × 40.)
A: Fibrous tissue replacing hyaline cartilage.
B: Eburnated subchondral bone.
C: Normal hyaline cartilage.

from seven to ninety-six days. In only one instance was an intra-articular adhesion found to bridge the elbow joint. The bone defect regenerated rapidly, but was covered with a thin layer of fibrous tissue in most cases. In the oldest fracture, small areas of fibrocartilage were found in the connective tissue. One specimen, thirty-nine days after operation, showed a restoration of the defect with a layer of hyaline cartilage which differed from normal cartilage only in the absence of a basal deeply staining layer.

The nine joints which had been immobilized after creation of a defect were observed from seven to 108 days. In two-thirds of these joints, fibrous adhesions were found extending between the articular surfaces of the humerus and the ulna. This finding would seem to demonstrate the importance of early motion in the treatment of fractures which involve joints. In this group also there were several instances of degener-

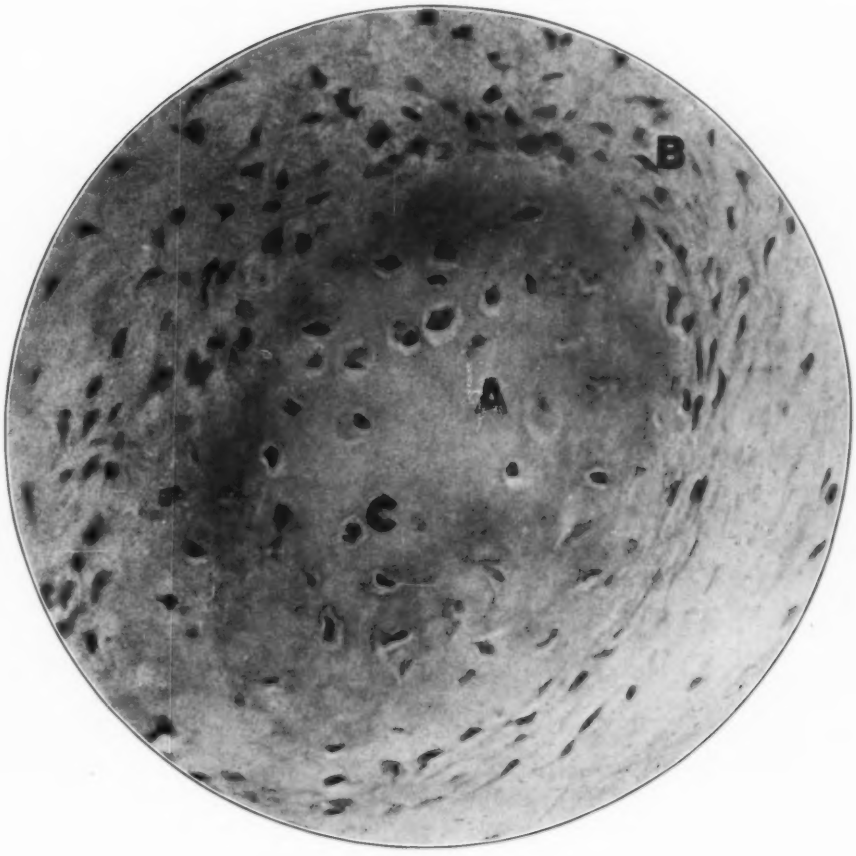

FIG. 7

Degenerated carpal navicular of Case 11, twenty-eight years after fracture. (Magnification × 500.)
A: Hyaline matrix.
B: Embryonic type of connective tissue.
C: Cartilage cell.

ation of the articular surface of the ulna in which no defect had been made. Repair of the defects, as in the preceding experiments, took place by the production of a layer of fibrous tissue on the newly formed bone. In the animal with the longest observation period (108 days), one can see the metaplasia of this fibrous tissue into hyaline cartilage.

The twenty-eight surgical specimens were obtained from patients suffering from a wide variety of articular injuries, which ranged in duration from five days to twenty-eight years. In contrast to the results observed in experimental animals, these clinical cases were almost without exception characterized by an absence of any evidence of regeneration of the cartilage. The only instances of metaplasia of connective tissue into hyaline cartilage were observed in two carpal bones affected by degenerative changes of many years' duration, and in a tarsal joint which had been subjected to an incomplete arthrodesing operation eleven months previously.

This failure of human articular cartilage to regenerate after injury is the basis for the permanent disability which so often follows fractures into weight-bearing joints. The importance of accurate anatomical reposition of the fragments in such fractures is evident. The surgeon should also use the greatest care, when exploring joints, to avoid any injury to the surface of the hyaline cartilage. The frequent observation of areas of degeneration of the articular surfaces of the knee at operations for the removal of fractured menisci has experimental substantiation in the work of King, who observed similar degenerative changes in the articular surfaces of the knees of dogs three or four months after he had excised parts of the medial menisci. These clinical and experimental findings indicate the importance of early removal of fractured menisci. They may also explain the persistence of pain in the knee on weight-bearing often seen in industrial practice after the excision of a meniscus.

CONCLUSIONS

1. An injury to articular cartilage which does not involve the subchondral bone is not repaired, because of the inability of fully developed hyaline cartilage to revert to a more embryonic type of connective tissue, which is the precursor of cartilage.

2. Experimental injuries which include articular cartilage and subchondral bone are repaired by the invasion of fibrous connective tissue from the underlying bone. After several months, the connective tissue resembles fibrocartilage and may show areas of metaplasia into hyaline cartilage.

3. The formation of intra-articular adhesions is favored by the complete immobilization of injured joints. Such adhesions tend to produce degenerative changes in any articular surface to which they become attached.

4. In man, articular cartilage has no power of regeneration, and the metaplasia of connective tissue into cartilage is rarely seen. Such metaplasia is more apt to result from a severe injury, with an accompanying destruction of subchondral bone, than it is to occur following injuries which involve the cartilage alone.

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AN OPERATIVE TECHNIQUE FOR HALLUX VALGUS

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From the Orthopaedic Department of the College of Medical Evangelists, Los Angeles

The operative procedure for the correction of hallux valgus which is herewith presented has been devised to utilize the tendon of the extensor hallucis longus as a direct antagonist to the oblique and transverse heads of the adductor hallucis muscles. This is done by translocating the long extensor of the great toe medially and passing it through a tunnel made by imbricating the now redundant capsule of the first metatarsophalangeal joint. The redundancy is resultant from the removal of the bony excrescence of the metatarsal head.

Thus, by reversing the bowstring (extensor hallucis longus tendon) from its previous position to its new site, medially, the chances for recurrences are at a minimum. Furthermore, the articular cartilage of the first metatarsophalangeal joint is undisturbed.

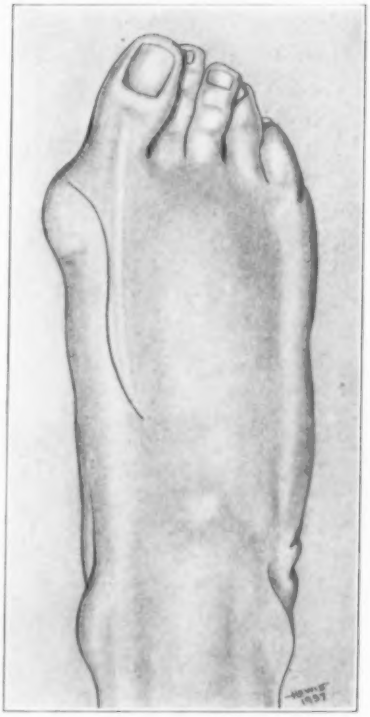

FIG. 1

TECHNIQUE

Through an S-shaped incision dorsomedially over the level of the first metatarsophalangeal joint (Fig. 1), the bursa and the capsule covering the bony exostosis are exposed (Fig. 2). The bursa is partially dissected from above downward, exposing the dense fibrous capsule of the first metatarsophalangeal joint. Then medially through an H incision, the capsule is incised and retracted (Figs. 2 and 3), so that the bony excrescence is in the operative field (Fig. 3). This exostosis (Fig. 4), together with the medial base of the proximal phalanx (Fig. 5), is removed, and the surface is smoothed. The previously taut capsule is then redundant (Fig. 5). The lower one-half of the capsule is imbricated with the upper posterior surface of the upper flap of the capsule (Fig. 6). The extensor hallucis longus tendon, inclusive of its paratenon, is then freed from its bed (Fig. 6), and, with its insertion undisturbed, this tendon is translocated to its new bed (bursa and lower one-half of the capsule). (See Figure 7.) The dorsomedial (upper) flap is then placed over the tendon and sutured inferiorly so as to

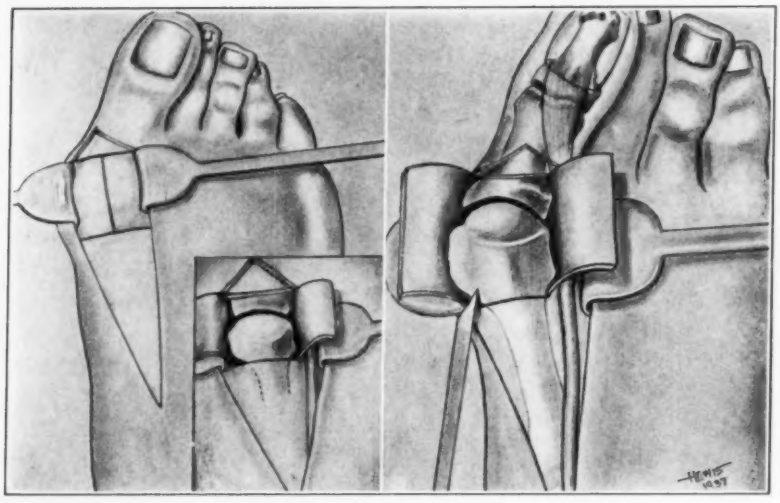

FIG. 2 FIG. 3 FIG. 4

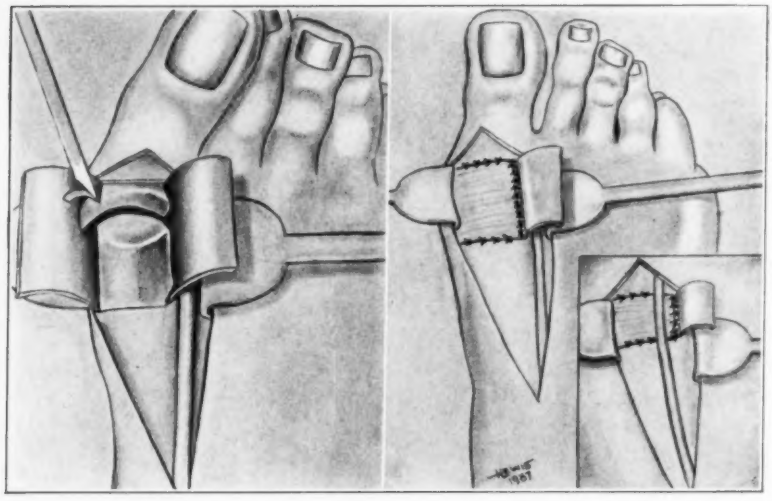

FIG. 5 FIG. 6 FIG. 7

make a canal (Fig. 8). During the entire suturing process an assistant keeps the great toe flexed, and, after the canal has been constructed, the toe is released and remains slightly adducted and flexed. The toe is easily moved from flexion to extension, since it now has a double gliding mechanism,—namely, the canal and the paratenon of the extensor hallucis longus tendon. The skin is closed and a tongue-blade splint is applied for immobilization of the joint for fourteen days.

After fourteen days the splint is removed (Fig. 9), and physiotherapy in the form of active and passive motion under water, followed by gentle massage, is instituted.

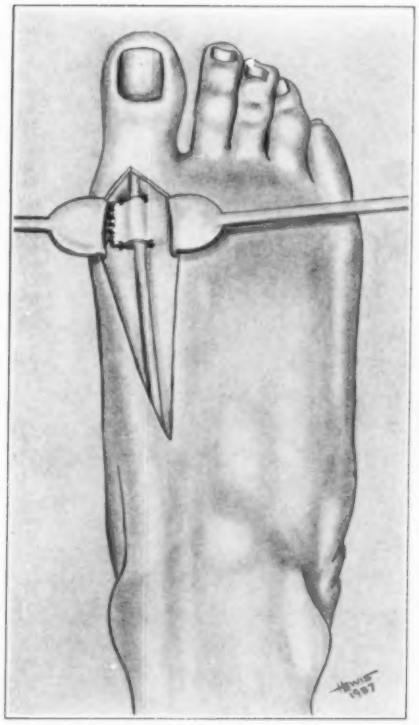

FIG. 8

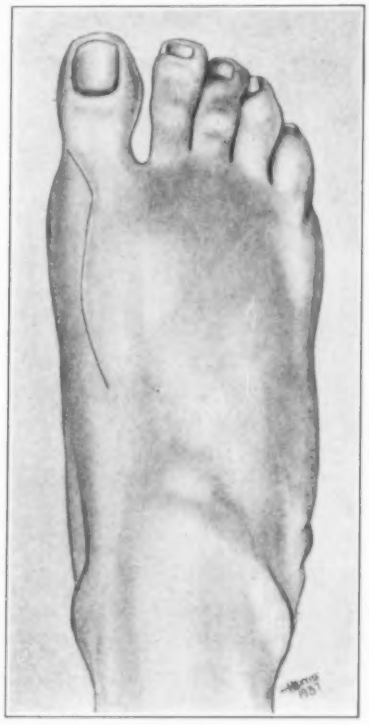

FIG. 9

This procedure has been carried out in ten cases. The end results, however, are yet to be reported. A follow-up examination in one case in which the operation was done two years ago revealed a painless metatarsophalangeal joint with full range of motion and no recurrence of the deformity.

RECURRENT ANTERIOR DISLOCATION OF THE SHOULDER

Report of Eleven Cases Operated on by the Method of Roberts

BY BURGH S. BURNET, M.D., F.A.C.S., HOT SPRINGS NATIONAL PARK, ARKANSAS

From March 1934 to October 1937, eleven patients with recurrent anterior dislocation of the shoulder were operated on by the author on the Orthopaedic Section of the Surgical Service, Letterman General Hospital, Presidio of San Francisco, California. The operation described by Roberts, in the January 1933 issue of *The Journal of Bone and Joint Surgery*, was used, with minor modifications, in all cases. The results were so satisfactory as to warrant presentation of the cases with a view to bringing again to the medical profession the merits of this procedure.

ANALYISS OF CASES

There were ten males and one female, varying in age from nineteen to forty-eight years. There were six recurrent dislocations of the left shoulder and five of the right. There were no patients with bilateral dislocations operated upon. The occupations of the patients were: enlisted men in the United States Army, five; commissioned officer in the United States Army, one; enrollees in the Civilian Conservation Corps, two; civilian radio announcer, one; student nurse, one; civilian employee (stevedore), one. Most of the patients were muscular young adult males of athletic habits.

The duration of habitual dislocation ranged from four months to six years.

All cases followed an acute traumatic anterior dislocation. There were no epileptics in the group.

Nine patients were followed up and reports were received from six months to three years following the operation. No recurrences were reported and in eight cases there was no disability. One of these nine patients, a stevedore, was examined six months after operation. He complained that he could not do heavy lifting on account of pain. Objectively there was practically full range of voluntary motion of the shoulder and good return of musculature. There had been no recurrence of dislocation.

The last patient of the series was operated on two months previous to the writing of this report. He has regained full motion of the shoulder and has no complaints. In one case the follow-up letter was not answered.

Five patients of the series had acute anterior dislocation of the shoulder, following minor trauma, which was reduced at this hospital. This confirmed their history of frequent dislocations. In the other six cases, diagnosis was made on the basis of the transfer diagnosis of a recently reduced dislocation in conjunction with the history, as obtained

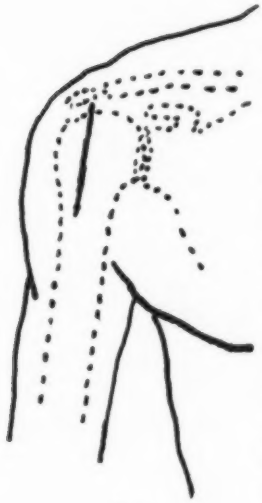

FIG. 1

The incision.

from the patient, of frequent dislocation due to slight injury or to awkward movement.

The average period of time from operation to return to work was seven weeks. It varied from one month and ten days to four months.

In Case 1 we experienced some difficulty in locating the bicipital groove. This was avoided later by placing the arm in slight abduction with the palm up. A line drawn from just within the anterior tip of the acromion to the antecubital fossa was found to follow approximately the bicipital groove. In addition, it was found easier to open the capsule of the joint and to follow the tendon down from within the joint.

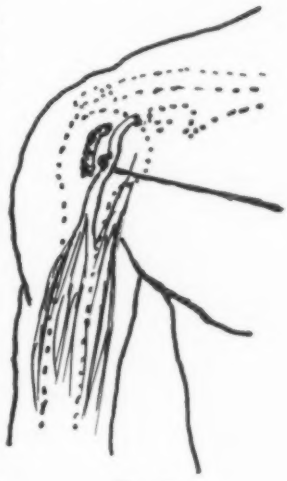

FIG. 2

The long tendon of the biceps is retracted, and the bicipital groove and the canal into the humeral head are gouged out.

In all cases we removed the synovial-membrane covering from that portion of the tendon to be fixed in the groove.

In Case 5 there was a superficial cellulitis of the wound, due to staphylococcus albus. This cleared up rapidly with drainage and dakinization and did not involve the deeper tissues.

In Case 6 the long tendon of the biceps was accidentally severed when it slipped out from under the retractor while the groove was being deepened with the gouge. Immediate suture of the tendon with black silk was performed. Follow-up of this case showed no resultant disability.

TREATMENT

In reviewing the literature on the treatment of habitual dislocation, one is impressed with the fact that the method of plicating the capsule has been practically discarded. T. Turner Thomas' operation of plication of the capsule through the axillary approach to its inferior angle undoubtedly gave good results. Keller, in the January 1925 issue of *Annals of Surgery*, reported eleven cases in which a modification of this method was used with excellent results. The operation required three assistants,—one to hold the arm in proper position, one to make the necessary deep retraction, and one to sponge and to catch and tie bleeding points. In the largest group of cases in which good results have been reported during the past few years, the following operations have been employed: the tenosuspension method of Henderson; the biceps-tendon-

fixation operation of Nicola; and the deltoid-sling operation of Clairmont and Ehrlich.

The simplicity of the Roberts operation, as compared with other methods, appealed to the author. Its principle seemed sound,—it converted the long tendon of the biceps within the joint capsule into a suspensory ligament in a manner similar to the Nicola method, but it avoided many of the technical difficulties of that operation.

TECHNIQUE OF THE ROBERTS OPERATION AS PERFORMED AT THE LETTERMAN GENERAL HOSPITAL

The operation is done under rigid aseptic methods. When the patient is on the operating table and the skin has been prepared, a flat sand bag is placed under the shoulder to hold it slightly raised. The arm is draped on an arm board in a few degrees of abduction and with the palm of the hand up.

With the exception of three cases in this series (Cases 8, 10, and 11) gas-oxygen-ether anaesthesia was employed.

The incision begins just below and very slightly medial to the anterior tip of the acromion and continues down through the skin and superficial fascia in the direction of the antecubital fossa for about four inches. All bleeding points are caught and tied.

The incision is then deepened by blunt separation of the upper fibers of the deltoid muscle until the capsule of the shoulder is reached. The capsule is picked up and opened with a straight incision, and the long tendon of the biceps is identified. The incision in the capsule is then carried down through the transverse humeral ligament, exposing the biceps tendon in the groove. The long tendon of the biceps is lifted out of the groove and retracted. With a gouge, the bicipital groove is deepened, all cartilage being removed from it, and this groove is then extended upward into the humeral head for about three-fourths of an inch.

The long tendon of the biceps is thoroughly roughened by rubbing it with gauze to remove its synovial covering. The tendon is then dropped back into the groove. Two or three interrupted No. 2 chromic sutures are passed through the transverse humeral ligament and through the long tendon of the biceps, anchoring it into place. The transverse humeral ligament and the opening in the capsule are then closed with interrupted plain catgut. The deltoid muscle is allowed to drop back into place, and the wound is closed and dressed.

The arm is then placed in a triangular sling tied tight enough to support the elbow. Over this is placed a muslin roller bandage about the arm and the body. This dressing holds the arm up and the shoulder in a position of adduction and internal rotation. The patient remains in bed for one week. The sutures are removed usually on the tenth day, but the sling and body bandage are not discarded before the twenty-first day, when, if the shoulder appears to be properly healed, active exercise, baking, and massage are commenced.

REPORT OF CASES

CASE 1. V. H. (No. 164543), white, male, aged forty-five years, a civilian stevedore, was admitted to the Letterman General Hospital on February 19, 1934, with a history of recurrent dislocation of the right shoulder, following a dislocation caused by a fall into the hold of a ship on October 10, 1933. The dislocation had been reduced on the same date. There had been repeated recurrent dislocations since that time, and these had been reduced at the Letterman General Hospital.

On March 1, 1934, an operation according to the method of Roberts was performed. The sutures were removed on the tenth day, and the wound healed *per primam*. Physiotherapy and active exercises were begun on the twenty-third day. The patient was discharged from the Hospital on May 18, 1934, at which time slight restriction of abduction and of external rotation and moderate weakness were present.

On September 5, 1934, examination showed voluntary abduction to 110 degrees and normal rotation of the shoulder, with full flexion and extension. The musculature was good. The patient has had no recurrence of the dislocation.

In this case, at operation, some difficulty was experienced in locating the long head of the biceps.

CASE 2. M. R. (No. 167052), white, male, aged twenty years, an enrollee in the Civilian Conservation Corps, was admitted to the Letterman General Hospital on September 5, 1934, with a history of recurrent dislocation of the left shoulder, following dislocation by a fall while carrying a bucket of water in May 1934. The dislocation had been reduced on the same date. There had been recurrent dislocations from awkward motions ever since. Roentgenographic examination of the left shoulder, on September 5, was negative.

The Roberts operation was performed on September 18, 1934. The sutures were removed on the seventh day, and the wound healed well. The patient was discharged on November 15, 1934, with a good range of motion in the left shoulder without pain. There was no recurrence of the dislocation. The patient could not raise the arm to the vertical position, but otherwise he had fully recovered. A follow-up letter sent to this patient was not answered.

CASE 3. E. J. F. (No. 168255), white, male, aged thirty years, a private in the Coast Artillery, was admitted to the Letterman General Hospital on December 10, 1934. He gave a history of recurrent dislocation of the right shoulder: the first dislocation had occurred in January 1927, while the patient was diving into a swimming pool; the second, in 1928, when he fell down a muddy slope. Following the second injury, the shoulder had been repeatedly out of place on the slightest exertion. In January 1935, at the Letterman General Hospital, while putting linen on a shelf, the patient again dislocated the shoulder. The dislocation was reduced immediately.

On January 31, 1935, the Roberts operation was performed. The sutures were removed on the eleventh day. The wound healed well, and, on the twenty-first day, active motion and physiotherapy were begun. The patient returned to duty on April 9, 1935, with a full range of voluntary motion in the right shoulder and good strength.

On November 28, 1937, the patient was again examined. He had just returned from a tour of duty in the Philippine Islands, and stated that he was able to perform full duty and to engage in athletics. He had played short stop on the baseball team, and the shoulder had given him no trouble. The dislocation had never recurred.

CASE 4. H. A. (No. 168686), white, male, aged twenty-two years, a private in the Medical Department, was admitted to the Letterman General Hospital on January 15, 1935, with a history of recurrent dislocation of the left shoulder following a dislocation when he had fallen to the wet deck of a ship while on duty in the United States Navy in 1931. There had been repeated recurrent dislocations from awkward motions since that date. The dislocation was reduced at the Letterman General Hospital on January 15, 1935. Roentgenographic examination of the left shoulder on that date was negative.

The Roberts operation was performed on January 22, 1935. The sutures were removed on the eleventh day, and the wound was found to have healed. On the twenty-third day, active exercise was permitted. On March 4, 1935, the patient returned to duty. He made an uneventful recovery, and strength and mobility of the shoulder steadily increased.

In December 1936, the patient was interviewed and stated that the shoulder had never again dislocated. He was able to dive, to swim, and to engage in other athletics.

CASE 5. R. J. H. (No. 171118), white, male, aged forty-eight years, an enrollee in the Civilian Conservation Corps, was admitted to the Letterman General Hospital on August 3, 1935, with a history of recurrent dislocation of the right shoulder following a dislocation sustained by falling down a flight of steps in December 1919. Since then, the shoulder had become dislocated two or three times a year. He fell against a door on August 2, 1935, and the shoulder dislocated. The dislocation was reduced at the Letterman General Hospital on August 4, 1935. Roentgenographic examination was negative.

On August 22, 1935, the Roberts operation was performed. On August 27, 1935, acute suppurative cellulitis developed in the operative wound. The wound was opened between the sutures and dakinized. Healing later took place. On September 26, 1935, the patient was discharged, with abduction of the shoulder limited to 90 degrees. Motion improved steadily. The wound had healed and the cellulitis of the operative area had entirely disappeared.

A letter from the patient, received on September 7, 1936, stated: "The shoulder has never been out of place and gives no trouble."

CASE 6. S. C. (No. 172137), white, male, aged twenty-one years, a private in the Field Artillery, was admitted to the Letterman General Hospital on November 7, 1935, with a history of recurrent dislocation of the left shoulder following a dislocation incurred about January 1930 in a wrestling bout at his home. There had been repeated recurrent dislocations since that date. On admission, slight atrophy of the left shoulder and a minor degree of weakness of the arm were noted.

The Roberts operation was performed on November 14, 1935. The sutures were removed fourteen days later, and the wound was well healed. Active motion was begun on December 4, 1935. The patient returned to duty on January 9, 1936, at which time there was a full range of voluntary motion of the left shoulder, with no pain.

On January 15, 1937, a letter from the patient stated that he had done hard labor in coal mines and that there was no stiffness of the shoulder. The joint had never again dislocated.

CASE 7. S. P. E. (No. 175153), white, male, aged thirty-nine years, weighing 215 pounds, a Major in the Field Artillery, was admitted to the Letterman General Hospital on July 5, 1936, with a history of recurrent dislocation of the left shoulder. The first dislocation of this shoulder had been sustained during a football game in 1919. The shoulder had again become dislocated during a football game in 1929; following this injury, there had been repeated recurrent dislocations. On June 1, 1936, the patient reached above his head, and the shoulder again became dislocated. The dislocation was reduced on the same day at the Letterman General Hospital.

The Roberts operation was performed on July 7, 1936. The sutures were removed on the tenth day, and the wound was well healed. The patient returned to duty on August 5, 1936, with nearly a full range of voluntary motion.

This patient was followed up for one year after operation. He engaged in strenuous physical activities; a full range of motion returned to the shoulder; and there was no further dislocation.

CASE 8. H. H. I. (No. 176090), white, male, aged twenty-two years, a private in the Infantry, was admitted to the Letterman General Hospital on September 24, 1936. He gave a history of recurrent dislocation of the left shoulder, following dislocation of this shoulder during a high-school football game in October 1931, which had been reduced on

the same day. There had been repeated recurrent dislocations since that time, — about a dozen in all. Roentgenographic examination, on September 25, 1936, was negative.

The Roberts operation was performed on September 29, 1936, under avertin reinforced by nitrous oxide-oxygen. The sutures were removed on the ninth day, and the incision was found to have healed. On the twenty-first day, the sling and bandage were removed, and active motion and physiotherapy were instituted. The patient returned to duty on November 14, 1936, at which time he had a full range of voluntary motion of the left shoulder and good strength.

On February 12, 1938, in answer to a follow-up letter, he stated: "The shoulder has never been out of place, and I can use my arm very well."

CASE 9. H. A. H. (No. 177494), white, male, aged twenty-five years, a radio announcer, was admitted to the Letterman General Hospital on October 28, 1936. He gave a history of recurrent dislocation of the right shoulder, following a dislocation incurred on October 28, 1933, in a football game, with six recurrences during the season. An operation, through an anterior incision, was performed elsewhere, but dislocation recurred two or three months later. Since that time, there had been repeated recurrent dislocations.

On October 29, 1936, the scar of the previous operation was excised, and the Roberts operation was performed. The sutures were removed on the eighth day. There was slight serous drainage from the lower angle of the wound. Five days later, the wound was well healed. On the twenty-first day, active exercise and physiotherapy were begun. The patient was discharged to his home a few days later with instructions to continue the exercise.

This patient was followed up for six months after the operation. There was no recurrence of the dislocation, and he had a full range of voluntary motion of the right shoulder. He stated that he swam and played baseball and tennis, using the right arm.

CASE 10. T. M. (No. 179615), white, female, aged nineteen years, a student nurse, was admitted to the Letterman General Hospital on June 20, 1937, with a history of recurrent dislocation of the right shoulder, following a dislocation incurred by a fall to the floor while playing basketball in September 1934. The dislocation had been reduced on the same date. One week later, she had reached above her head, and the shoulder dislocated again. There had been repeated recurrent dislocations since that time.

The Roberts operation was performed on June 22, 1937, under avertin anaesthesia. The sutures were removed on the tenth day, and the incision was found to have healed. On the twenty-first day, active exercise and physiotherapy were instituted. The patient left the hospital shortly after this.

On November 2, 1937, the patient was again seen. She had a full range of voluntary motion of the right shoulder, and there had been no further dislocation. She stated that she could use the arm freely in her duties as a student nurse.

CASE 11. F. C. (No. 180920), white, male, aged twenty-one years, a private in the Infantry, was admitted to the Letterman General Hospital on October 18, 1937. He gave a history of recurrent dislocation of the left shoulder, following a dislocation sustained in a fall on the outstretched arm during a baseball game in the summer of 1933. There had been about thirty recurrences of the dislocation during the past four years.

The Roberts operation was performed on October 21, 1937, under avertin anaesthesia. Eight days later, the sutures were removed, and the incision was found to be well healed. On the twenty-first day, all dressings were discarded, and active exercise was begun.

On November 26, 1937, a full range of voluntary motion of the left shoulder had been regained. There was good strength in the arm, and the patient had no complaint.

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THE RESULTS OF TREATMENT OF OSTEOGENIC SARCOMA *

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Because of the current interest in the subject of osteogenic sarcoma and the lack of agreement among those who are experienced in dealing with this disease, the author has made a further study of the results of treatment at The Mayo Clinic from 1909 through 1934. Early in the study it became obvious that such tumors are rare; the incidence was about one (0.00025 per cent.) in every 4000 patients who entered The Clinic. In the period of twenty-six years covered, there were 216 cases of osteogenic sarcoma; in 187 of these, tissue was available for microscopic verification at the time of the original diagnosis, and in the remaining twenty-nine, diagnosis was based on clinical and roentgenographic findings. The average age of the patients when they presented themselves at The Clinic was 29.3 years; the youngest was three years of age and the oldest, seventy-seven years. There were 126 males (67.4 per cent.) and sixty-one females (32.6 per cent.). Trauma was a possible factor in 44.9 per cent. of the cases. The average duration of symptoms before the patients came to The Clinic was 10.4 months.

The tumors in the 187 cases were reexamined histopathologically and, whenever possible, the grade of malignancy was determined according to the method of Broders [1, 2, 3]. There was a slight increase in the percentage of so-called five-year cures in comparison with those reported in the author's previous publications: the percentages in the papers published in 1922 [5] and in 1935 [8] were 16.5 per cent. and 18 per cent., respectively, while the percentage of five-year cures in the cases in which the diagnosis was proved microscopically for the entire period is 23.4 per cent.

In a paper presented before the American Orthopaedic Association in Washington, in 1923 [6], it was stated that, although the vast majority of bone tumors (including osteogenic sarcomata) can be diagnosed from the clinical and roentgenographic findings, there is a small group of bone tumors which defy the efforts of the most expert clinical or roentgenological diagnosticians, and some of them do not reveal their identity until metastasis or death occurs. This is true to a lesser extent of those tumors which are diagnosed microscopically, but the percentage of correct findings is higher than when reliance must be placed on clinical or roentgenographic means only.

The writer was not surprised when a distinguished surgeon, who was participating in a symposium on malignancy of bone, asked an eminent pathologist what he meant by the adjective "osteogenic". The reply was

* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 3, 1938.

that the word meant "arising from bone-producing cells". Thus, an osteogenic sarcoma is a malignant tumor which develops from tissue that is predestined to form bone, and the term "osteogenic sarcoma" denotes many of the growths previously designated by terms such as "osteosarcoma", "chondrosarcoma", "osteochondrofibrosarcoma", "osteochondrofibromyxosarcoma", etc.; among these terms, also, should be mentioned "periosteal osteogenic sarcoma". When one of the foregoing mixed terms is used, the intention, as a rule, is to denote the type of tissue which is predominant in the tumor. The anatomical terms "periosteal" and "central" have been generally discarded in relation to sarcoma, as have also the roentgenological terms "sclerosing" and "osteolytic", except when they are used in a more or less colloquial sense. However, the terms "periosteal fibrosarcoma" and "periosteal osteogenic sarcoma" are still employed to denote tumors which continue to be recognized. Periosteal fibrosarcomata [9] (Fig. 1) probably arise from the outer portion of the periosteum or neighboring tissue; they may cause absorption of bone or, later, invasion and these processes may give rise to the supposition that the growth is a primary bone tumor. Periosteal osteogenic sarcoma (Fig. 2) apparently arises from the corticoperiosteal tissue and produces true bone, or osteo-

FIG. 1

Periosteal fibrosarcoma of upper part of arm. Involvement of shaft of humerus is secondary and the tumor is not producing any bone.

FIG. 2

Periosteal osteogenic sarcoma producing bone, the roentgenographic appearance of which resembles a sunburst. This tumor involved the central and cortical bone as well as the soft tissue.

genic sarcoma. Broders and Pemberton [4] have reported finding an osteogenic sarcoma in the thyroid gland, but growths in such unusual situations are not of concern in this study.

Moreover, it is not the author's purpose to present a review of the results of investigations reported by other physicians. A correct diagnosis is the prime requisite in the scientific evaluation of results of treatment of osteogenic sarcoma, as the subsequent history not infrequently proves the first opinion to have been incorrect. Thus, in this series of 187 cases, the tissue has been reexamined microscopically by expert pathologists in an attempt to group the tumors as to the degree of malignancy. On the basis of this reexamination, the original diagnoses have been revised when necessary.

In all of these cases, roentgenograms of the lungs were made to exclude the presence of visible metastasis. The method of treatment employed was not always the method of choice, because patients and relatives failed to follow the advice given by their surgeons and preferred to have the less mutilating procedures carried out. Should immediate amputation be urged, the patient is likely to flee to a physician who is believed to be more conservative. This may result in loss of precious time and only after failure of conservative methods does the patient consent to radical surgical treatment. Thus the delay in amputation in Case 1 might be condemned, but the original recommendation by the surgeon was rejected, and three years passed before the patient consented to amputation.

The follow-up record of today is more efficient than it was in the past, but one is still confused when confronted by the various types and combinations of treatment employed in various parts of the country. The patients go from one physician to another, and treatment is seldom carried out in one place; this results in a variety of diagnoses and advice. Were it possible to see immediately every patient who has a painful condition of bone, and if clinical and roentgenographic examinations could be made by expert physicians, an early diagnosis could be made and a more favorable prognosis given.

Surgical treatment is more or less limited, and in some cases it is impossible to obtain more than a section of tissue for diagnosis. The situation and size of the tumor and the previous treatment must be taken into consideration. A glance at Figure 3, which discloses the situation of the malignant osteogenic tumors, is convincing. The skill and judgment of the surgeon in selecting and carrying out the method of treatment best suited to the individual patient are other important factors in the results. The argument for amputation is at times more attractive than another operation which might result in the necessity of prolonged care, in recurrence, in ulceration, and possibly in a charge of negligence if further consultation should demonstrate metastasis. Moreover, many patients live long distances from adequate and skillful radiologists and cannot afford, or will not take the time, to go to institutions for frequent reexamination. In a few instances also, the danger of sterility, because of the situation of

the tumor, causes the patient to refuse irradiation. Rarely is a physician in general practice willing alone to pass judgment, to assume responsibility for the diagnosis, and to carry out treatment in cases of bone sarcoma. Early accurate diagnosis, institution of the selected method of treatment, and evaluation of the result of treatment reach their maximal worth when the cooperation of specialists is available. Thus, the great medical centers and the Registry of Bone Sarcoma of the American College of Surgeons offer the physician the facilities of experts in this field.

RADIUM OR ROENTGEN THERAPY

Before 1920, systematic radiotherapy for tumors of this kind was, to all intents, not used at The Mayo Clinic. Since 1920, increasing use of radium or roentgen rays has been made in selected cases. More and more the tendency has been to use multiple converging beams, the quality of the rays varying according to the mass of tissue in which the tumor is situated. Preoperative irradiation, as now understood, has not been tried. By force of circumstances, treatment has been almost entirely postoperative, some patients receiving all their treatment at The Clinic, while others have received part of their treatment at The Clinic and part at home.

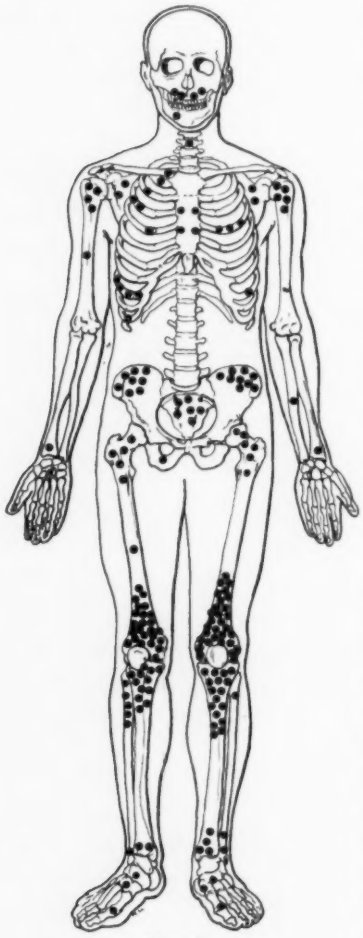

FIG. 3

Situation of 187 osteogenic sarcomata. (See Table I.)

The writer believes that no one but a radiologist who has had special experience in the treatment of these tumors should undertake to use radium or roentgen rays in these cases. By placing treatment in such hands, the danger of untoward results is diminished.

The twenty-nine patients concerning whom diagnosis was made from clinical and roentgenographic findings received irradiation therapy or irradiation therapy and Coley's toxins. Of these, the author was able to trace twenty-seven and of this latter number only two (7.4 per cent.) lived more than three years and none survived five years. Approximately two-thirds of these patients died of metastases in less than one year. Since these patients could not be grouped as to the degree of malignancy, and some doubt may exist as to the accuracy of the diagnosis of osteogenic sarcoma, they

TABLE I

SITUATION OF 187 OSTEOGENIC SARCOMATA *

Situation	Right			Left			Total	
	Upper	Middle	Lower	Upper	Middle	Lower	No.	Per Cent.
Femur	5	1	24	6	0	30	66	35.3
Tibia	12	0	2	17	0	4	35	18.7
Humerus	4	1	0	5	0	0	10	5.3
Fibula	5	0	1	1	0	2	9	4.8
Radius	0	0	1	1	0	0	2	1.1
Ulna	0	0	0	0	1	0	1	0.5
Ilium							17	9.2
Ribs							15	8.1
Feet							6	3.3
Sacrum							6	3.3
Jaw							5	2.6
Scapula							4	2.1
Spine							4	2.1
Sternum							4	2.1
Hyoid bone							1	0.5
Clavicle							1	0.5
Ischium							1	0.5
Total							187	100.0

* Note the percentage of tumors in the region of the knee, the humerus, and the pelvis.

will not be included in any of the additional statistics given in this paper.

As has been said, when these twenty-nine patients were excluded, 187 remained from whom tissue was available for microscopic examination at the time of the original diagnosis. Of these 187 patients, 184 were traced. Of the 184 traced patients, some received Coley's toxins and 40 per cent. of those who did receive this treatment survived three years. Of those patients who did not receive Coley's toxins, 34 per cent. survived three years. The five-year survival rate among those patients who received Coley's toxins was 26 per cent., whereas that of the patients who did not receive this treatment was 23 per cent. Although there is a slight advantage in survival in favor of the patients who received Coley's toxins, it is difficult to evaluate its significance. In the first place, only twenty-five patients received this treatment. Also, the treatment was carried out

TABLE II

CASES OF OSTEOGENIC SARCOMA IN WHICH HISTOLOGICAL SPECIMENS WERE AVAILABLE, GROUPED BY HISTOLOGICAL GRADE (BRODERS' METHOD)—SURVIVAL AFTER TREATMENT

Group	Lived Three or More Years after Treatment				Lived Five or More Years after Treatment			
	Patients Treated*	Patients Traced	Patients	Percentage of Traced Patients	Patients Treated*	Patients Traced	Patients	Percentage of Traced Patients
Grade 1	17	17	11	64.7	12	10	6	60.0
Grade 2	39	39	13	33.3	33	33	5	15.1
Grade 3	39	39	8	20.5	36	36	6	16.7
Grade 4	25	24	4	16.7	19	18	2	11.1
Not graded	67	65	28	43.1	66	61	18	29.5
Total	187	184	64	34.8	166	158	37	23.4

* Inquiry as of January 1, 1938. The three-year group comprises the patients treated three or more years prior to the time of inquiry,—that is, 1934 or earlier. The five-year group comprises those treated in 1932 or earlier,—that is, the five-year treated group is included in the three-year table. The column "Patients Traced" in the three-year table includes those treated patients who have been traced for three years or more; the same column in the five-year table represents the treated patients who have been traced five years or more. A patient treated five years or more prior to the time of investigation and known to be alive three years after treatment, but lost track of after that time, will be included in the treated group of both tables, but in the traced group of only the three-year table, since such a patient has been traced for three years after treatment, but not for five years.

by home physicians and the author was dependent on their reports as to the administration of the toxins. Moreover, the treatment as respects irradiation and surgical measures was not uniform in this group.

The writer had no experience with treatment by means of lead in this series of 187 cases of osteogenic sarcoma.

As the author expressed the opinion in 1934 [8] that one of the most important ways of classifying osteogenic sarcoma was by grading the degree of malignancy, it was gratifying to confirm the fact that expectancy of life and result of treatment were actually influenced by the grade of malignancy as determined by the pathologists. Of the 187 cases in which tissue was available for microscopic verification at the time of the original diagnosis, in 120, or 64 per cent., the malignancy of the tumors was graded. The five-year survival rates are given in Table II. To be sure, the high rate of survival of patients whose tumors were of Grade-1 malignancy is based on a comparatively small number of cases. However, this large survival rate in the presence of malignancy of low grade agrees well with all studies made at The Clinic in regard to the significance, with respect to survival, of grading of the degree of malignancy of other tissues. It is justifiable to feel confident of the soundness of the general conclusion that, in the presence of tumors of low-grade malignancy, prognosis for five-year survival is considerably better than it is in the

presence of tumors of higher grades of malignancy, even if the more conservative surgical measures are employed in the treatment of the tumors of lower grade.

BIOPSY

In four cases biopsy alone was performed. (See Table III.) In two of these, the tumor was in the bony pelvis and the patients died seven and eighteen months after the specimen was taken. One patient had a tumor of the ribs and died one month after biopsy; in the remaining case, the tumor was in the upper part of the humerus, and the patient died five months after excision of the specimen.

Biopsy is of value if there is any question as to benignancy or malignancy of a lesion of bone; it is of value, also, in making possible the grading of a malignant lesion. The experience of the pathologist is directly related to the value of biopsy. The surgeon must be certain that the material he submits to the pathologist is true tumor tissue and, if the histopathological diagnosis is not in agreement with his clinical opinion, more tissue should be examined. As a rule, the author prefers the open operation in performing a biopsy, for it permits inspection of the tumor and allows sufficient tissue to be obtained from a typical portion of the

TABLE III

CASES OF OSTEOGENIC SARCOMA IN WHICH HISTOLOGICAL SPECIMENS WERE AVAILABLE, GROUPED ACCORDING TO TREATMENT—SURVIVAL AFTER TREATMENT

Group	Lived Three or More Years after Treatment				Lived Five or More Years after Treatment			
	Patients Treated*	Patients Traced	Patients	Percentage of Traced Patients	Patients Treated*	Patients Traced	Patients	Percentage of Traced Patients
Biopsy only	4	4	0		4	4	0	
Irradiation only	38	37	6	16.2	35	33	3	9.1
Excision **	56	55	28	50.9	49	44	15	34.1
Amputation **	89	88	30	34.1	78	77	19	24.7
Total	187	184	64	34.8	166	158	37†	23.4

* Inquiry as of January 1, 1938. The three-year group comprises the patients treated three or more years prior to the time of inquiry,—that is, 1934 or earlier. The five-year group comprises those treated in 1932 or earlier,—that is, the five-year treated group is included in the three-year table. The column "Patients Traced" in the three-year table includes those treated patients who have been traced for three years or more; the same column in the five-year table represents the treated patients who have been traced five years or more. A patient treated five years or more prior to the time of investigation and known to be alive three years after treatment, but lost track of after that time, will be included in the treated group of both tables, but in the traced group of only the three-year table, since such a patient has been traced for three years after treatment, but not for five years.

** With or without irradiation.

† Of the thirty-seven patients who lived five years or more, five, or 13.5 per cent., had received Coley's toxins.

TABLE IV

OPERATIONS BY GRADE OF MALIGNANCY

	Total	Biopsy		Excision		Amputation	
		No.	*Per Cent.*	*No.*	*Per Cent.*	*No.*	*Per Cent.*
Grade 1	17	2	11.8	15	88.2	0	0.0
Grade 2	39	13	33.3	9	23.1	17	43.6
Grade 3	39	9	23.1	5	12.8	25	64.1
Grade 4	25	6	24.0	5	20.0	14	56.0
Not graded	67	12	17.9	22	32.8	33	49.3
Total	187	42*	22.5	56†	29.9	89	47.6

* Thirty-three patients also received irradiation; five received irradiation plus Coley's toxins.

† Forty-four patients also received irradiation; two received irradiation plus Coley's toxins.

tumor. The tourniquet is employed whenever possible, and every care is taken to minimize trauma to tissue. Taking of material for biopsy by means of a needle is useful if tumors are vascular and difficult of approach; some osteogenic sarcomata make such a procedure difficult. The writer has found biopsy and the cooperation of a skilled pathologist of inestimable value in clearing up the question of diagnosis in that group of cases wherein there is some doubt as to the true nature of the lesion. Furthermore, grading of the degree of malignancy may alter the decision as to the type of treatment and prognosis.

IRRADIATION FOLLOWING BIOPSY

The percentage of five-year cures among traced patients who were treated by irradiation following biopsy was 9.1. All such treatment was not carried out at The Clinic, for it was necessary to cooperate with roentgenologists near the homes of some of the patients. Irradiation was employed because it was selected by the patient in preference to surgical treatment or because the size or situation of the tumor made its removal impossible. Regression of the growth and temporary improvement were noted in some cases; atrophy of bone and soft tissue and stiffness of joints occurred in others. With further knowledge and development of irradiation, improved results may make it the method of choice, but the author's experience to date has indicated that osteogenic sarcoma is inadequately responsive to this form of treatment. (See Table III.)

EXCISION

Excision of osteogenic sarcoma was performed in a large number of cases when the degree of malignancy was low, when the tumors were of

such size and were so situated as to make amputation impossible, or when the patient refused to have more radical procedures carried out. When excision is performed in the early stages of the disease and the degree of malignancy is low, expectancy of life is increased and a functioning extremity may be preserved. When recurrence takes place, however, in spite of postoperative irradiation and treatment with Coley's toxins, late amputation may be contra-indicated because of metastasis. Complete excision of bone, followed by adequate irradiation, may result in extensive scarring; then reconstructive surgical treatment, such as bone grafting, may result in formation of an ulcer, loss of the graft, and, finally, amputation. Of the 187 patients herein considered, twenty-seven, or 14.4 per cent., came to The Clinic following previous excision; fifty-three, or 28.3 per cent., had some form of surgical treatment, irradiation, treatment by means of Coley's toxins, or a combination of these. Of forty-four patients treated by excision, with or without irradiation or administration of Coley's toxins, and traced for five years, fifteen (34.1 per cent.) lived five years or more. (See Table III.)

AMPUTATION

Consent to amputation is given by the patient or responsible relatives only when the more conservative measures have failed or the condition has become unbearable as a result of pain, disfigurement, or disability. Thus, amputation is often of a palliative nature, permitting the patient a period of relief from symptoms, during which time there is a temporary gain in weight and improvement of morale. Postoperative irradiation, as well as administration of Coley's toxins, is employed in the hope of destroying unrecognized metastatic growths. Although a considerable fraction of the writer's patients who came to amputation had undergone previous conservative surgical treatment, or combinations of surgical treatment with irradiation and administration of Coley's toxins, instead of early amputation, the five-year survival rate after treatment at The Clinic was 24.7 per cent. (See Table III.)

The site of amputation should be well away from the tumor. Patients frequently insist on saving length of limb and thus risk the possibility of early local recurrence. The author prefers amputation above the knee if a tumor is about the ankle, and through the upper part of the femur if the tumor is about the knee, saving enough of the extremity, when possible, for use of a prosthetic apparatus. If a tumor is in the region of the elbow, high humeral amputation or disarticulation at the shoulder usually is employed.

CHOICE OF OPERATION

In the foregoing paragraphs much has been written about the choice of operation. The operations employed in the 187 cases, in relation to the grade of malignancy of the tumors, are recorded in Table IV. If the malignancy was of Grade 1, amputation was never employed. There was no operative mortality in this series of 187 cases.

The following cases illustrate some of the points made in this paper. Some patients refused amputation when it possibly would have given a favorable result. In other cases the tumor was in an inaccessible location, and the only possible treatment was irradiation.

REPORT OF CASES

CASE 1. A woman, aged thirty years, was admitted to The Clinic with the complaint of pain, stiffness, and swelling about the left knee of two months' duration. She had lost forty pounds (eighteen kilograms) in the past two years.

Her height was five feet, six inches (168 centimeters) and her weight 117 pounds (fifty-three kilograms). Her blood pressure was slightly elevated and her temperature was normal. A firm, immovable, smooth mass, which was somewhat tender, was palpable on the medial and anterior aspects of the left knee. There was no local increase in warmth, and no redness or enlargement of veins, but there was limitation of flexion of the knee. General examination, including urinalysis, blood count, and flocculation test, gave negative results. Roentgenograms of the thorax were negative. The roentgenologists were of the opinion that the tumor was an osteochondroma. (See Figure 4.)

A clinical diagnosis of sclerosing osteogenic sarcoma of the lower part of the left femur was made. Biopsy with a tourniquet in place and, providing the tissue proved malignant, amputation were advised. The patient refused biopsy and amputation and was referred for roentgenotherapy, courses of which were given from time to time.

The first course, which was given in May 1931, consisted of irradiation over six fields; there were two rows of three fields each, the dividing line between the upper and lower rows corresponding to the center of the tumor. Each field was irradiated as follows: voltage, 135 peak kilovolts; filtration, six-millimeter aluminum; focal-skin distance, forty centimeters; milliamperes, five; time, twenty-eight minutes; dose, 560 roentgen units (total dose, 3360 roentgen units). The second course of treatment was given in June 1931, over six fields; the conditions of irradiation were the same as for the first course. The third course was given in July 1931; the conditions of irradiation were the same as for the first and second courses, except that each field received 520 roentgen units (total dose, 3120 roentgen units). The fourth course was given in August 1931, and was similar in every respect to the third course. The fifth course was given in September 1931, over six fields, each receiving 500 roentgen units (total, 3000 roentgen units). The sixth course was given in October 1931, and was exactly the same as the fifth course.

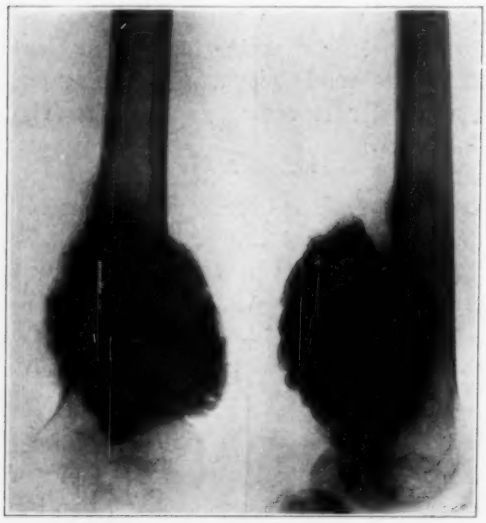

FIG. 4

Case 1. Osteogenic sarcoma of the lower part of the left femur.

Subsequent to these courses of treatment, the patient still refused to have amputation performed and, as examination of the thorax was negative, the patient was finally dismissed in December 1931, at which time her condition was definitely improved and she had gained weight.

In January 1932, she received eleven injections of Coley's toxins

under the supervision of her local physician, after which she refused to continue with this form of treatment.

A member of the American Orthopaedic Association, who examined this patient eighteen months following treatment, wrote: "This looks like a cure of sarcoma by x-ray . . . lengthening of the tendo achillis was performed." The patient stated at this time that she was in perfect health and believed that she was cured. Three years and a half after she had been advised to undergo amputation at The Clinic, this was performed elsewhere and the woman died three months later. At necropsy, the diagnosis of metastasis to the lungs was confirmed.

In order to save space in the following reports of cases, the writer has not given treatment by irradiation in detail.

CASE 2. A man, aged twenty-one years, injured the right ilium thirteen months previous to his admission. Two months later, pain developed in the knee and stiffness in the hip. A diagnosis of osteogenic sarcoma of the right ilium was made by the clinician and the roentgenologist. (See Figure 5.) Roentgenograms of the thorax were negative for metastasis. The patient received twelve local treatments by irradiation and died six months later.

CASE 3. A boy, aged sixteen years, had had pain in the right shoulder, without trauma, of six months' duration. Examination disclosed a tumor of bone. Roentgenograms of the thorax were negative for metastasis. Clinical and roentgenographic diagnoses of osteogenic sarcoma of the upper part of the right humerus were made. (See Figure 6.) Amputation was refused and treatment by irradiation was given. The patient died of pulmonary metastasis seven months later.

CASE 4. A man, aged twenty years, complained of loss of weight of fifteen pounds (seven kilograms) and of pain and swelling of the right ilium. He did not give a history of trauma. A diagnosis of tuberculosis was made elsewhere and, on aspiration, "blood and white material" were obtained. The roentgenologists at The Clinic found roughen-

FIG. 5

Case 2. Osteogenic sarcoma of the right ilium involving the hip joint.

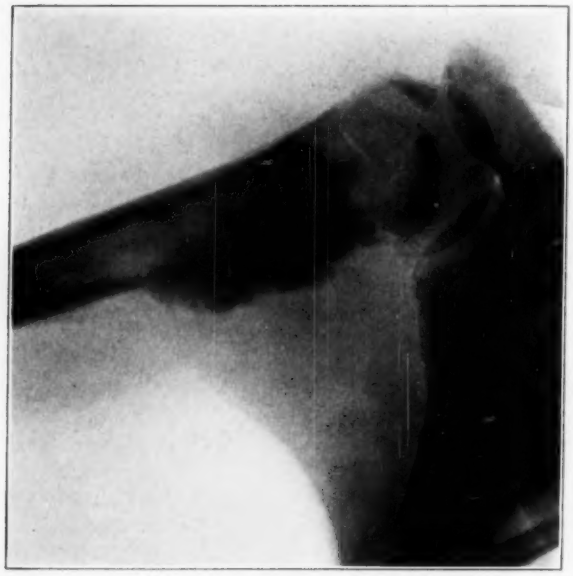

FIG. 6

Case 3. Osteogenic sarcoma of the upper part of the right humerus.

ing and erosion of the ilium, suggestive of sarcoma, but no evidence of pulmonary metastasis. Biopsy resulted in a diagnosis of osteogenic sarcoma. Pulmonary metastasis occurred eleven months following the onset of symptoms. Five months following biopsy the patient died.

CASE 5. A man, aged fifty-three years, had been given a diagnosis of tuberculosis of the seventh cervical vertebra and had received treatment for this and for neuritis. On examination, one year following the onset of symptoms, the roentgenologist considered the possibility of the presence of Pott's disease and found the thorax negative for metastasis. The clinician felt that malignancy was more likely to be the underlying condition, and biopsy proved that an osteogenic sarcoma (Grade 4) was present and was causing radiculitis from compression. Twelve treatments with high-voltage roentgen rays were given during the

FIG. 7

Case 7. Osteogenic sarcoma of the upper part of the left femur.

FIG. 8

Case 9. Roentgenogram of gross specimen giving evidence of osteogenic sarcoma of the left lower tibia.

ensuing months. The patient's death two years after biopsy was ascribed to toxaemia resulting from malignancy.

CASE 6. A married woman, aged forty-one years, had submitted to excision of a tumor of the third thoracic vertebra, and subsequent irradiation, three times in seven years. On admission to The Clinic, she complained of pain and swelling. Roentgenograms of the thorax were negative for metastasis. A fourth excision was performed and irradiation given in 1927. In 1934 she returned with a recurrence, and the fifth excision was performed, followed by irradiation. In 1937 she underwent excision a sixth time and she was last heard from in October 1937, ten years and five months following her first operation at The Clinic, or about seventeen years and six months following onset of symptoms. The pathologist, on reviewing the tissue, classified the tumor as an osteogenic sarcoma (Grade 1).

CASE 7. A girl, aged eleven years, after having been treated for sciatic pain for six months, was brought to The Clinic because of pain and swelling in the upper part of the left femur. A clinical diagnosis of sarcoma and a roentgenographic diagnosis of osteochondroma were made. (See Figure 7.) Roentgenograms of the thorax were negative for metastasis. Excision was performed and the pathologist reported osteogenic sarcoma (Grade 3). Radium therapy (14,000 milligram hours) was given. The patient wrote on April 1, 1938, that she was in good health; this was seven years following excision.

CASE 8. A man, aged twenty-one years, complained of pain in the left shoulder; this had immediately followed an injury sustained six months previous to admission. Roentgenograms of the thorax were negative. The clinical and roentgenographic diagnoses of osteogenic sarcoma were substantiated by microscopic examination, which disclosed that the malignancy was of Grade 2. The patient refused treatment and returned home. Five months later, an inquiry revealed that he had died.

CASE 9. A girl, aged fifteen years, complained of pain and swelling of eight months' duration, in the lower part of the left tibia. She did not give a history of trauma. A diagnosis of osteomyelitis had been made. The roentgenograms of the thorax were negative for metastasis. A diagnosis of sarcoma was made and amputation was performed through the upper part of the tibia (Fig. 8); following this she received treatments by irradiation. She was living and well April 1, 1938, sixteen years and three months following treatment.

CASE 10. A boy, aged sixteen years, complained of persistent pain and swelling in the upper part of the left tibia following an injury sustained nine months previous to his admission. Roentgenograms of the thorax were negative. A diagnosis of sarcoma was made (Fig. 9) and amputation through the middle of the thigh was

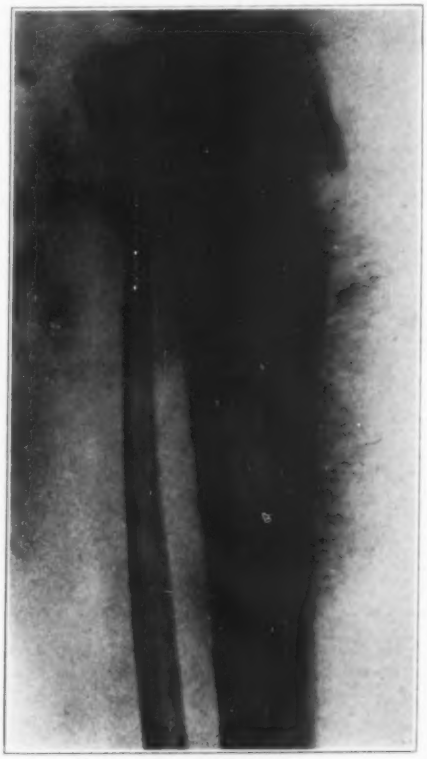

FIG. 9

Case 10. Periosteal osteogenic sarcoma of the upper part of the left tibia.

FIG. 10

Case 11. Postoperative osteogenic sarcoma of the left ulna.

performed. Fourteen months later, and just previous to the patient's death, roentgenographic examination disclosed pulmonary and pelvic metastases. He had not received other treatment.

CASE 11. A girl, aged seventeen years, gave a history of having injured the left ulna one year previous to admission. Following the injury, symptoms developed and the attending surgeon diagnosed osteomyelitis; he then operated for this condition. Examination revealed a large tumor of the forearm, with local pain, swelling, and warmth. A diagnosis of sarcoma was made by the clinician and the roentgenologist. (See Figure 10.) Roentgenograms of the thorax were negative for metastasis. Certain factors made it advisable for us to have microscopic proof of the diagnosis and, on examination of tissue removed, the pathologist reported osteogenic sarcoma (Grade 4). Irradiation treatment was chosen by the patient, and ten courses of low-voltage roentgenotherapy were given. Six months later an attempt was made to carry out a conservative operation. The patient died of pulmonary metastasis twenty-eight months from the onset of symptoms.

Early diagnosis resulting from roentgenographic examination and microscopic grading of the degree of malignancy, together with prompt amputation, might improve the expectancy of life in such a case.

CASE 12. A married woman, aged fifty-six years, had injured the right humerus two and a half years previous to admission; five months later, slight pain and swelling had developed in this region. Local excision had been performed and fifteen treatments with Coley's toxins had been given elsewhere, fourteen months previous to her arrival at The Clinic. At The Clinic a diagnosis of huge recurring sarcoma of the humerus, with pathological fracture, was made. (See Figure 11.) Roentgenograms of the thorax were negative for metastasis. An intrascapular thoracic amputation was performed and the pathologist reported the presence of osteogenic sarcoma. The patient took Coley's toxins under direction of her physician at home. In a report received April 1, 1938, twenty-one years following amputation, she stated that she was in good health.

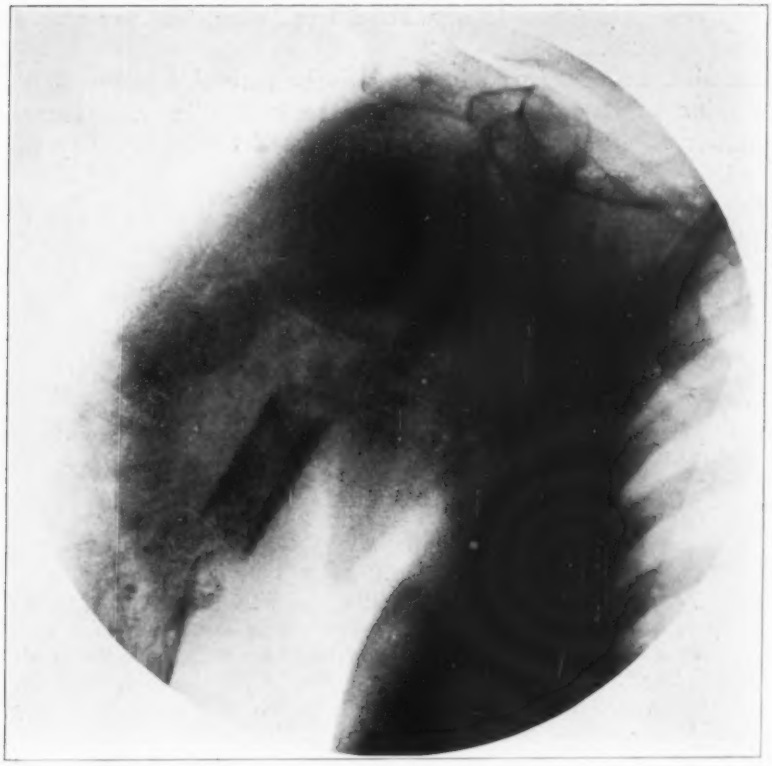

FIG. 11

Case 12. Postoperative osteogenic sarcoma with pathological fracture of the upper part of the right humerus.

SUMMARY

Knowledge as to the therapeutic value of the methods of treatment in cases of osteogenic sarcoma depends on accurate records and follow-up reports of clinician, roentgenologist, surgeon, and pathologist. The incidence of this rare malignant tumor was one in 4000 patients who presented themselves at The Mayo Clinic for treatment.

The relation of the grade of malignancy of osteogenic sarcomata to the survival of the patients was similar to that which exists in the presence of malignancy of other neoplasms of other tissues.

Patients whose tumors were of a low grade of malignancy had the highest record for five-year survival. Grade 1 was associated with a five-year survival rate of 60 per cent.; Grades 2 and 3, with an average five-year survival rate of 15.9 per cent.; and Grade 4, with a five-year survival rate of 11.1 per cent.

Of those patients treated by irradiation only, and traced for five years, 9.1 per cent. lived five years or more; of those treated by excision, with or without irradiation, 34.1 per cent. lived five years or more; and of those

treated by amputation, with or without irradiation, 24.7 per cent. lived five years or more.

Excision was employed in a relatively favorable group of cases. Amputation sometimes was used with the understanding that it was only a palliative measure; it was not used at all if the malignancy was of Grade 1.

Of 158 patients treated by any method, and traced for five years, 23.4 per cent. lived five years or more after treatment.

CONCLUSIONS

When every painful bony structure is subjected to thorough roentgenographic examination, bone tumors will be diagnosed earlier. When these early cases come into the hands of those experienced in diagnosis, in grading the degree of malignancy, and in unbiased choice of treatment, more limbs will be saved and more lives prolonged.

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ROENTGENOTHERAPY IN ACUTE OSTEOPOROSIS

A New Type of Treatment *

BY E. B. MUMFORD, M.D., F.A.C.S., INDIANAPOLIS, INDIANA

Osteoporosis is that condition of bone in which there has occurred a demineralization or an absorption of the mineral salts of the bone, and it is manifested by a thinning of the bone shadow in the roentgenogram.

Osteoporosis is usually characterized as acute or chronic. Perhaps a better classification would be based upon the presence or absence of symptoms. It is only too often impossible to determine the time of the onset of the demineralization, and the change is discovered only when the parts are x-rayed for some other condition with which the osteoporosis is associated.

The symptom-free type of osteoporosis is found in disuse, endocrine disturbances, chemical poisoning, infection, nutritional diseases, and lesions of the central nervous system and of the circulatory system. The bone salts reappear as a rule when the associated condition has been removed. In this type, the roentgenographic study shows a diffuse uniform general thinning of the bone. In the extreme type, especially in those cases involving large areas such as the spine and the pelvis, the cortex is a thin, penciled white line, and the medullary portion of the bone is represented by a faint outline of the longitudinal trabeculae. Stereoscopically the bone looks like a box made of parchment and filled with cobwebs. Tuberculosis of the hip joint is associated with an atrophy which is characterized by a very marked thinning of the cortex. (See Figure 2.) This symptom-free type of osteoporosis is not a subject of discussion at this time.

The type of osteoporosis with symptoms is usually called "acute bone atrophy" or "Sudeck bone atrophy". It is this type alone which will be discussed.

The history of acute osteoporosis is usually that of a trivial injury, such as a bruise or a sprain, to the foot or the hand and wrist, although it may be found in association with more severe lesions, especially Colles' fractures and fractures of the calcaneum. It is rather characteristic that those parts composed of small bones (red marrow) and multiple joints are most frequently involved.

Following the injury or trauma to the part, there may not at first be any external evidence of a serious change in the bone,—the skin is normal in color and the function of the parts is undisturbed by pain. Within a comparatively short time, the patient complains of a severe throbbing ache, which is constant and which is *not relieved by heat or by rest.* The skin

* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 3, 1938.

FIG. 1

Generalized osteoporosis (cause unknown). Note the compression of isolated vertebrae without a history of accident.

becomes shiny, the parts are swollen, and the tenderness is severe on the lightest pressure. The local temperature in the early stages may be elevated, but later the skin feels cold and assumes a bluish color. At this later stage, there is an increase in the swelling, and the stiffness limits motion to a varying degree. In a few instances, small superficial abscesses have formed, but trophic changes have not been observed. In no instance did a purulent arthritis develop.

In acute osteoporosis with symptoms, the roentgenographic appearance is more or less characteristic. The cortex is fairly well preserved. The medullary portion gives a mottled, moth-eaten shadow, and the longitudinal trabeculae are not so well defined as in the other type. If the long bones are involved, the demineralization usually affects the entire shaft (Fig. 11) and is not limited to the ends of the bone as one observes in relation to fractures and to joint infections.

The course of the disease is characterized by persistent pain and a marked loss of function which does not respond to any form of treatment. After many months or even years (in one case the foot was totally disabled for two years) the symptoms may subside, but the prognosis is so uncertain that the condition has been grouped with the "self-limited diseases".

The cause of osteoporosis is not known, and any discussion of this phase of the lesion only leads one into a field of theories and hypotheses of the relationship of circulatory, nervous, chemical, inflammatory, and endocrine influences to the bone change as revealed by the roentgenogram. Osteoporosis is only one more of the many unexplained phenomena of bone, that tissue which is perhaps the most fluid and which is the most easily influenced of all body tissues. The reading of the literature on bone demineralization is interesting, but yields no definite conclusions.

The pathology of the osteoporotic bone has been studied in but few instances, as rarely is there an indication for operation or an opportunity for post-mortem examination. Gurd found the haversian canals to be much widened and the cortex thin. Fontaine and Herrmann in gross examination of porotic bone found the cortex to be brittle and the medullary portion almost completely replaced by adipose tissue.

That the treatment of osteoporosis with symptoms has been most unsatisfactory may be conceded. No plan suggested has given universal success. Heat in all forms, partial and complete fixation, massage, active use, and passive manipulation have, in the author's experience, all failed. Periarterial sympathectomy (Leriche), nerve blocking (Turner), minimum of immobilization followed by active movement (Sudeck), heat and light massage (Noble and Hauser), thyroid and parathyroid extracts (Delorme), heliotherapy (Peck), elevation of the affected part followed by the application of a light plaster splint (Gurd), and administration by ionization of parasympathetic stimulants (Middleton) are some of the suggestions for treatment. The variety and the number of these suggestions indicate their value.

FIG. 2

Osteoporosis following tuberculosis. Note the thin cortex.

The use of roentgenotherapy in osteoporosis was suggested to the author as an empirical form of treatment by the report of Turner, who relieved his patients by injecting the sensory nerve to the affected part with alcohol, and by the report of Kahlmeter of his experience with roentgenotherapy in arthritis. If osteoporosis is caused by some chemical substance liberated at the terminals of the sensory nerves in the bone tissue when these nerves are stimulated (pain) by some extraneous and unknown cause (inflammation), upon which theory Turner based his nerve blocking, and if roentgenotherapy (the analgesic effect possessed by the roentgen ray, although unexplained, is common knowledge) will relieve pain, the use of roentgenotherapy in osteoporosis is an apparently rational form of treatment. The results obtained in a few cases through roentgenotherapy were so startling that this preliminary and perhaps abortive report is presented in order that other surgeons may follow the suggested plan of treatment and either prove or disprove its value. It must be understood that relief was not

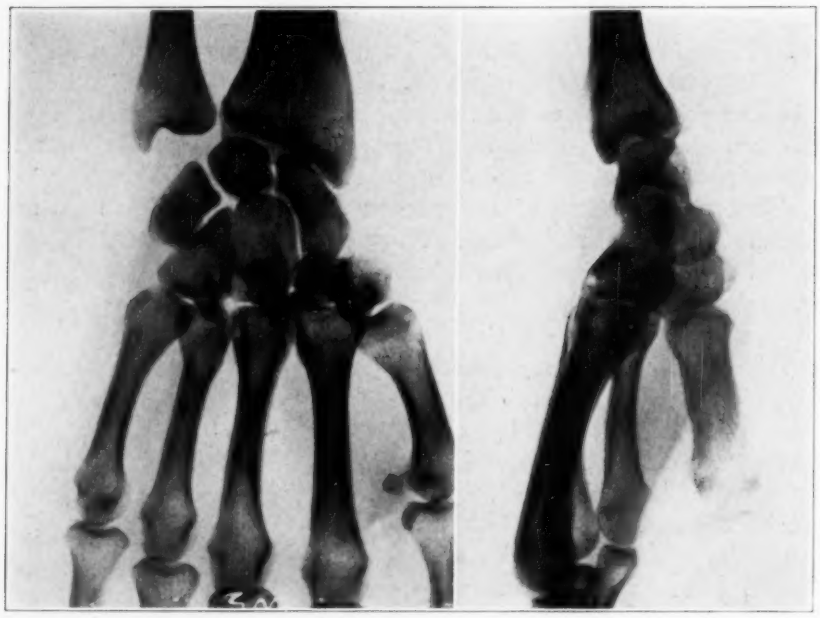

FIG. 3

Case 1. Two weeks after injury. There is no atrophy. Note the fracture line in the navicular.

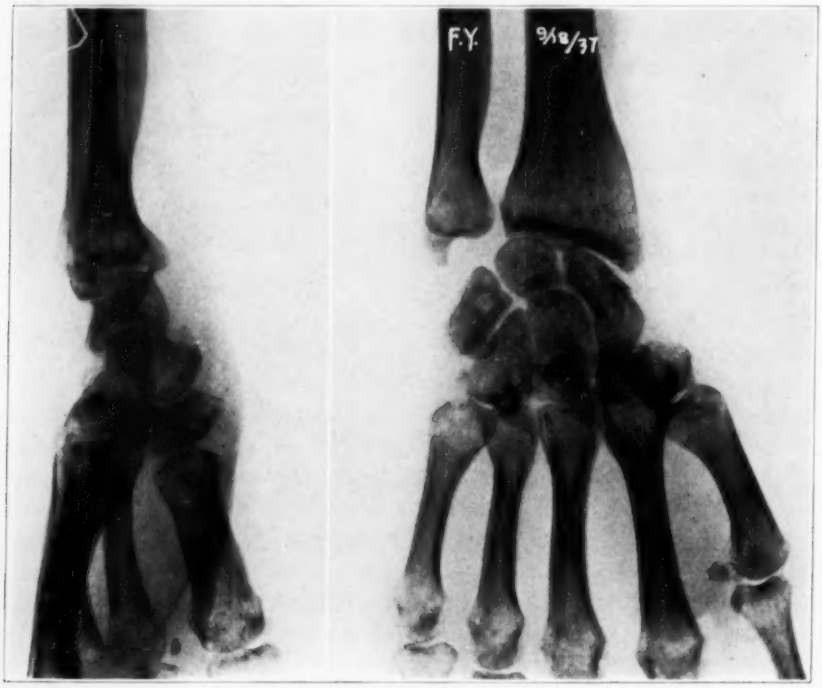

FIG. 4

Case 1. Five weeks after injury. Acute osteoporosis.

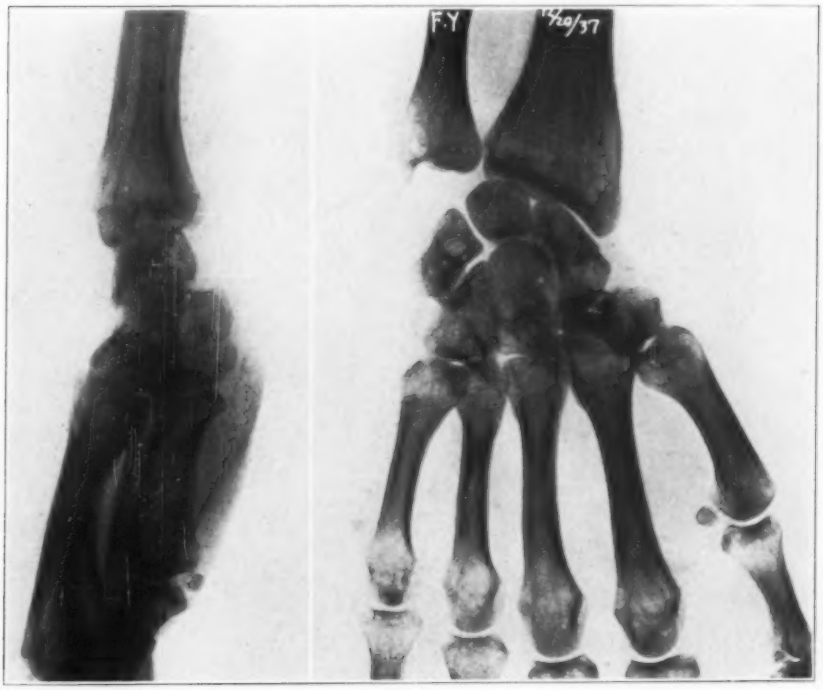

FIG. 5

Case 1. Three months after roentgenotherapy. Note the increased density in the bone.

obtained in all cases. However, roentgenotherapy can be advised on the basis that it may do some good and that it will not do any harm, as the dosage is not sufficient to produce an erythema.

The dosage is that suggested by Kahlmeter (Stockholm) and his article is quoted as follows:

"The tube output is 173 kw. (kilowatt) at a current of 6 milliamperes, and the filter used is equivalent to 0.5 Cu I Al. The focal distance is 30 cm., except for fields the size of 15 to 20 cm., where we use 40 cm. The field generally used measures 10 to 15 cm., although 8 to 10 cm. is also employed. With the above technique I SED in a field of 10 to 15, is equal to 1,000 r. . . . It will be seen, therefore, that in most cases we give in one series single doses of 150 to 200 r (1/7 to 1/5 SED), repeated two to three times at an interval of two to three days. After the lapse of four to six weeks we give, if needed, a second series of treatment of exactly the same dosage, and sometimes after still another six to eight weeks a third series of irradiations."

The following cases are reported with full knowledge that the number is small. It will be noted that the treatment in Case 6 not only resulted in failure, but the condition progressed during the time that roentgenotherapy was used.

Cases 4 and 5 brought out another subject for discussion. In each of these cases not only was the pain relieved, but, without any other form of treatment, the stiffness and loss of function in the joints disappeared

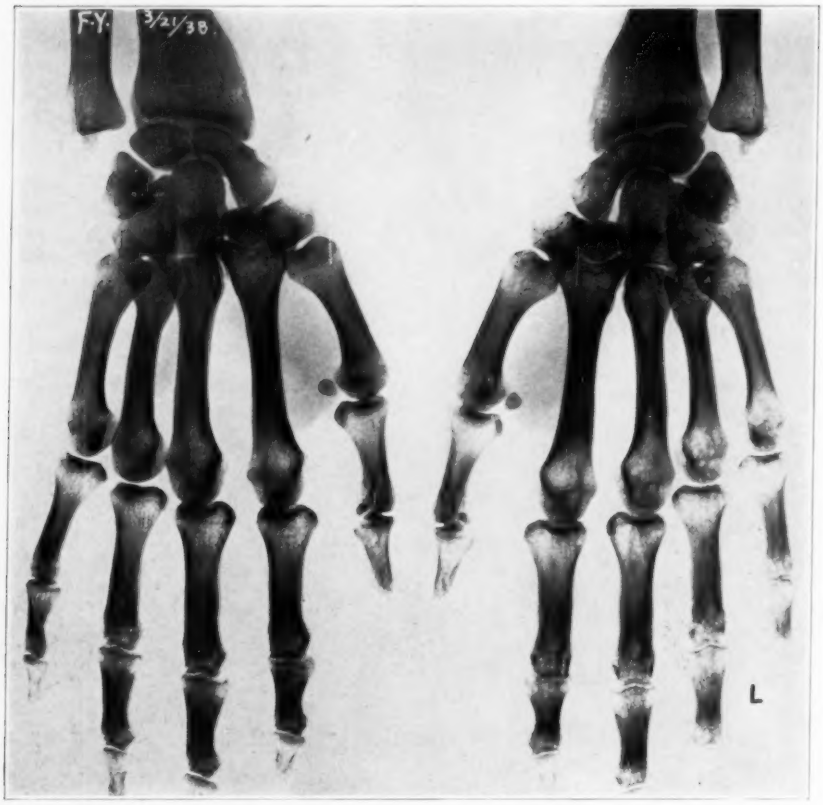

FIG. 6

Case 1. Six months after roentgenotherapy. In comparison with the normal right hand, the left hand still shows involvement.

entirely. Each of these cases was associated with an inflammatory process, and the complete recovery suggests that in this type of lesion the stiffness is not due to adhesions in and about the capsules and tendons, but is entirely the result of muscle spasm, and that when the pain is relieved the muscle spasm disappears and function is returned. This thought has been supported further in a few cases of low-back ache in which complete relief of symptoms has followed roentgenotherapy.

CASE REPORTS

CASE 1. (*Figures 3, 4, 5, and 6.*) F. Y., female, aged twenty-six years, a cashier in a drug store, fell and injured the left wrist on July 5, 1937. At that time the injury was considered a sprain and the wrist was merely strapped and carried in a sling. Two weeks after the accident the patient was first examined by the author. Roentgenographic examination showed a fine line in the navicular, which the author considered to be a fracture. There was no osteoporosis at that time.

The hand and forearm were placed in a plaster splint for fixation. The next week the patient complained of constant pain and aching both day and night, which was so severe that a narcotic was necessary. After ten days of fixation, the splint was removed and roentgenographic examination revealed a very marked osteoporosis in the bones of

the wrist and hand. At this time the hand was swollen and dark red in color. The local temperature was lower than that of the opposite side; there was almost complete loss of motion in the wrist and fingers; and the patient complained of exquisite pain in the wrist and especially in the little and ring fingers. Any attempt to move the fingers or wrist caused marked pain.

Roentgen-ray treatments were given, and almost immediately there was a return of normal color to the skin. The swelling disappeared, and function returned to the fingers and wrist, so that the patient was able to resume her duties ten days after the last treatment. However, she still had some pain, especially in the little and ring fingers.

This patient has been observed on several occasions since the roentgen-ray treatments and there has not been any return of the severe symptoms, but she still has some pain and discomfort in the little and ring fingers, although not sufficient to keep her from working. She states that with this hand she has used the cash register on an average of 1,500 times a day.

This case was settled before the Industrial Board on the basis of 10-per-cent. permanent partial impairment to the hand as a whole.

Case 2. H. H., male, aged twenty-six years, a machinist, on August 6, 1937, sprained the left foot through a simple twist. At that time there was no abrasion on the foot, but it became quite swollen, and five days later his physician made an incision over the dorsum of the foot. There was some drainage of a serous exudate for a period of about three weeks, and then the wound became healed. Associated with the swelling was severe pain, which was practically constant day and night and was aggravated whenever the patient attempted to do any work or to bear any weight or had any pressure on the toes.

This patient was examined by the writer on November 16, 1937, three months after the initial injury. He stated that he had not been able to do any work since the date of the accident on account of the pain in his foot.

At the time of the examination, the foot was swollen, the skin was glossy, and the temperature of the foot seemed to be somewhat below that of the opposite side. The mid-foot, especially, was very tender to even the slightest pressure. Motion in the ankle joint, in the mid-tarsal region, and in the toes was very much limited, and any attempt to produce motion caused the patient to complain of pain. Roentgenographic examination showed a marked osteoporosis involving the bones of the foot.

This patient was given a series of roentgen-ray treatments. Within a day or two following the last treatment, the swelling had entirely disappeared, the color of the foot had returned, the patient was free from pain, and there was but very little loss of function in the foot as a whole. This patient was observed several times, the last occasion being on March 1, 1938, and upon that date the foot was normal in appearance, there was no circulatory disturbance, and the patient had only slight pain upon weight-bearing.

Fig. 7

Case 3. Osteoporosis of the tarsal bones.

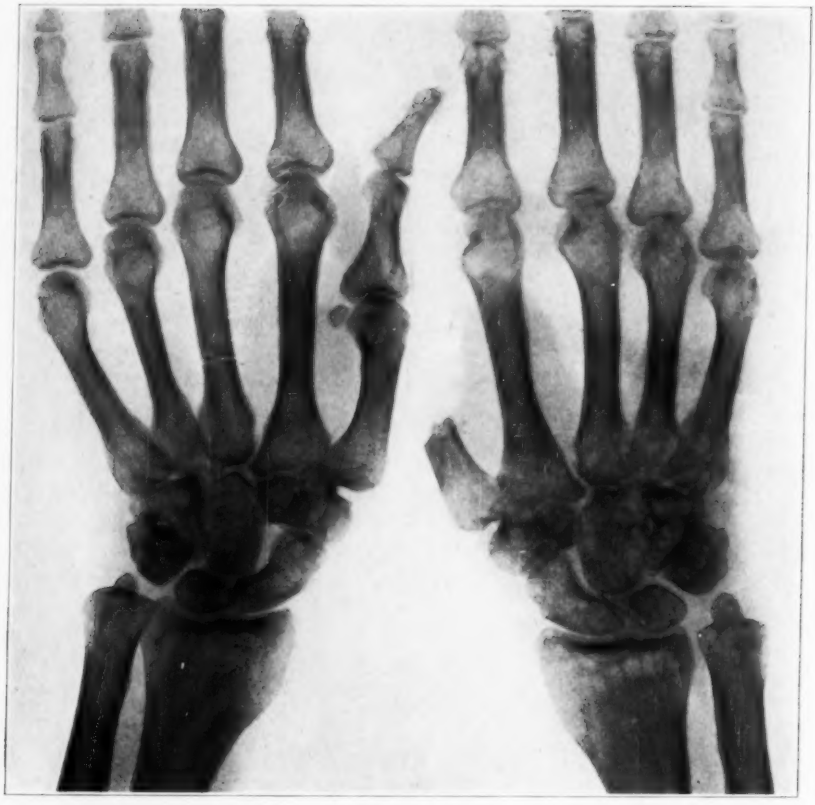

FIG. 8

Case 4. Acute osteoporosis following infection and amputation of the thumb. Complete return of function followed roentgenotherapy.

This case was settled before the Industrial Board on a basis of 10-per cent. loss of the foot as a whole, this impairment being due to some slight pain upon weight-bearing.

CASE 3. (*Figure 7.*) R. E., male, aged thirty-two years, a fireman, on October 14, 1937, while sliding down a pole, landed with considerable force, causing an injury to the right ankle. At that time he did not consider the condition to be serious, but the following day he began to have pain and swelling in the foot and was unable to work as a fireman after that time.

Roentgenographic examination showed a possible fracture of the second cuneiform bone.

Upon examination, on December 18, 1937, the foot was swollen and bluish in color, the temperature was lower than that of the opposite foot, there was considerable loss of motion in the ankle joint as well as in the mid-dorsal region of the foot, and the patient complained of tenderness to the slightest pressure over the entire foot. Roentgenograms taken at that time showed a very marked demineralization of the mid-tarsal bones of the foot.

This patient was given roentgen-ray treatments and was able to return to his work at the end of two weeks. Upon examination on March 1, 1938, he was at work as a fireman and had but very little pain in the foot as a whole.

CASE 4. (*Figure 8.*) H. G., male, aged fifty-seven years, a laborer, on September 16, 1937, struck a piece of brick with the right thumb, causing a compound fracture of

the phalanx. One week later, infection developed, and one month after the accident, the thumb was amputated at the metacarpophalangeal joint. Following this amputation, there was considerable swelling in the hand as a whole and also in the wrist. This patient was first seen by the author on December 22, 1937. He complained of very marked pain in the wrist and hand as a whole, and there was at least 90-per cent. loss of function in the fingers and wrist through loss of motion in the joints. The hand was described by his wife as looking like that of a dead person, being of a light bluish cast, cold, and extremely tender to touch.

Roentgen-ray treatments were instituted and after the second dose the color of the hand became normal and the pain became less severe. One week after the last treatment had been given, the patient was entirely free from pain, the color of the hand was good, swelling had disappeared, and there was only about 25-per cent. loss of function in the fingers and wrist. At the end of two more weeks, this patient had a normal hand so far as the fingers and wrist were concerned, both as to function in the joints and as to relief from pain, except for some tenderness over the amputation stump.

This patient was seen again on March 1, 1938, and at that time he had a normal hand and wrist, with the exception of the loss of the thumb, and he was able to do any work that was possible in view of the absence of the thumb.

CASE 5. (*Figures 9-A and 9-B.*) J. H., male, aged nineteen years, a laborer, on August 27, 1937, sustained a compound fracture of the left calcaneum. This was an extensive compound crushing wound, and the entire lateral side of the heel sloughed away with loss of some of the bone substance of the body of the calcaneum. The patient was treated by his local physician until November 26, at which time he was referred to the author for examination and treatment.

The patient complained of constant pain and aching in the foot, together with considerable loss of motion in the ankle joint and in the foot as a whole. For many weeks he had had to use amytal to obtain sleep. There was a large ulcer, or granulating wound, on the outer side of the heel, and he was sent to the hospital for treatment. At that time the writer suggested that he be given roentgen-ray treatments for the cleaning up of the skin in preparation for a future skin graft. After the third treatment, the patient stated that the pain had almost entirely disappeared from the foot and that function had returned to a very considerable degree. He was given further roentgen-ray treatment, and a skin graft was done. He was discharged from the hospital at the end of one month, at which time the skin graft had covered over the granulating area.

This patient has been observed frequently since the roentgen-ray treatments were given, and on March 1, 1938, he was practically free from pain in

FIG. 9-A

FIG. 9-B

Case 5. Acute osteoporosis following compound fracture of the calcaneum. Complete return of function followed roentgenotherapy.

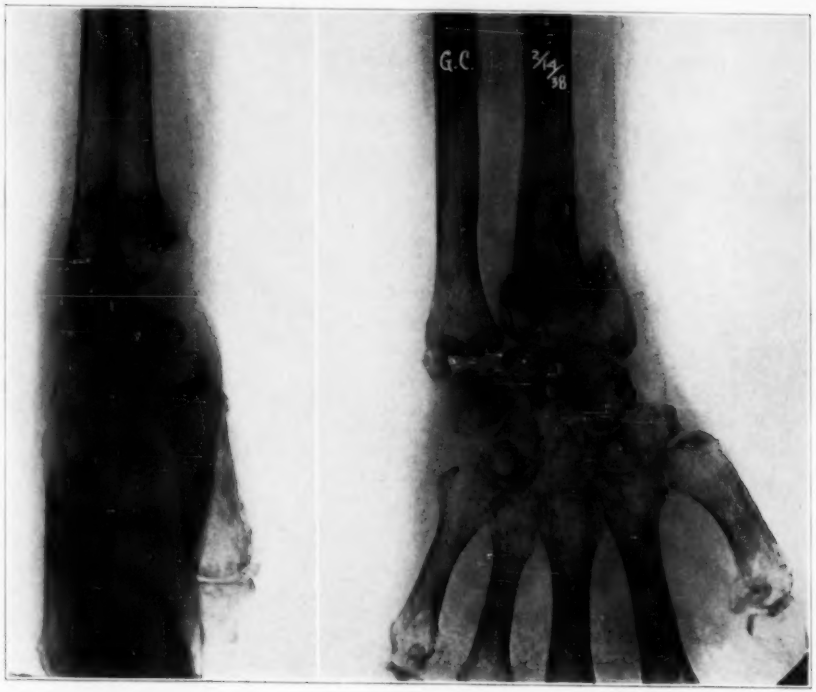

FIG. 10

Case 6. Acute osteoporosis following Colles' fracture. Roentgenotherapy was of no value. (See Fig. 11.)

FIG. 11

Case 6. Acute osteoporosis of ulna, radius, and humerus.

the foot except upon weight-bearing, and then the pain was not extreme. He is able now to walk without a cane or crutch. Motion in the foot is practically normal.

CASE 6. (*Figures 10 and 11.*) G. C., female, aged fifty-five years, a maid, fell on December 27, 1937, and fractured the lower end of the radius (Colles' fracture). There was a considerable amount of impaction. Two attempts at reduction under local anaesthesia were made, but full length of the radius was not obtained, although the articulating surface of the radius was restored to normal position. From the time of the accident the patient had considerable pain in the wrist with swelling of the wrist and hand. Fixation was maintained for four weeks with no cessation of pain. Subsequent roentgenograms showed an osteoporosis of the carpal bones and lower portion of the radius and ulna. Roentgenotherapy was given without any relief of pain. The splints were removed at the end of the fifth week. There was considerable loss of function in the fingers and wrist; the parts were swollen and very tender; and the skin was shiny and of a bluish cast.

About the sixth week, the patient complained of pain in the forearm and upper arm. Roentgenograms taken at that time showed a moderate degree of osteoporosis of the shafts of the humerus, radius, and ulna and a very marked thinning of the shadow of the bones of the hand and wrist. A second course of roentgenotherapy proved to be of no value. The patient now (at end of four weeks) is somewhat improved under short-wave diathermy and dry heat, but the hand and wrist are slightly swollen and the function of the fingers is greatly impaired. Most of the pain is now in the upper arm. This case did not respond to treatment of any type.

CONCLUSIONS

1. Osteoporosis should be classified as being with or without symptoms.

2. The type with symptoms (the acute bone atrophy of Sudeck) responded to roentgenotherapy in five out of six cases treated.

3. The roentgen-ray dosage is of such a type that erythema or burns will not occur.

4. In some cases of loss of function in joints associated with an inflammatory condition of the adjacent soft parts, the roentgen-ray apparently relieved the pain which was producing muscle spasm, and function of the joint returned.

5. The suggested roentgenotherapy for osteoporosis is purely empirical, and further proof of its true value is necessary.

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A REVIEW OF THE CAMPAIGN FOR THE ESTABLISHMENT OF SURGICAL PRINCIPLES IN THE TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR

BY ROYAL WHITMAN, M.D., NEW YORK, N. Y.

At the beginning of this century, fracture of the neck of the femur was a therapeutic derelict. The futility of conventional treatment, demonstrated by Sir Astley Cooper, had been accepted as a finality and permanent disability as an inevitable sequence of the injury.

The clue which was to indicate the way of escape from this therapeutic Slough of Despond came to light in 1890 when the writer identified a case of fracture of the neck of the femur in a child. This was reported as a surgical curiosity, since at that time the injury was regarded as an attribute of old age.

In succeeding years, a number of similar cases were brought to the hospital for the treatment of hip disease, for, although in each instance the fracture had united, a limp and discomfort persisted. The x-ray was not then available for diagnosis, but the elevation of the trochanter, indicating a corresponding depression of the neck, afterward called "coxa vara", demonstrated the mechanical nature of the disability. This was remedied by the removal of a sufficient wedge of bone from the base of the trochanter to restore the range of abduction.

This experience was enlightening, for it demonstrated the direct relation of the inclination of the neck of the femur to the normal gait. It was further evident that, if the angle of the neck could be restored by this indirect method, the characteristic deformity in this class of cases might be easily corrected at the time of the injury by adjusting the shaft to the neck,—namely, by abducting the limb and rotating it inward.

It then appeared, on further investigation of the mechanics of the joint, that the same manoeuver would be equally effective for the treatment of a complete fracture of the neck proper, for abduction and inward rotation of the limb after the shortening had been reduced would appose the fragments in a horizontal plane, while tension on the enclosing capsule would force a resistant contact.

It was evident, furthermore, that muscle action, which Sir Astley Cooper had found impossible to control, was entirely eliminated as an agent of displacement. It remained, therefore, only to support the limb in full abduction and extension by a plaster spica to assure the security of the internal splinting.

Thus it appeared that by the utilization of anatomical mechanics the opportunity for functional repair might be assured for all types of fracture at the hip.

Although the efficiency of what was called from its most salient feature the "abduction method" could be easily demonstrated, it made

little impression on a profession taught "that the ideal object of treatment, restoration of form and function, was rarely to be attempted or even sought".

Neglect of the fracture in the alleged interest of the patient entailed no responsibility, either moral or legal. Positive treatment, by contrast, could appeal only to adventurous spirits, since the correction of deformity might "break up the sacrosanct impaction", the only hope of union, while the restraint of the plaster spica must endanger the life of the patient.

Furthermore, the command of anatomical mechanics for the attainment of a definite object, to be supplemented by the construction of a comfortable and efficient plaster support, called for a much higher standard of technical preparedness than had ever been available in the treatment of this neglected injury.

During the lapse of years, however, in spite of opposition and inertia, the abduction treatment has come into general use, and experience has disproved every assumption on which the negative doctrine was based. It has been demonstrated not only that repair of the transcervical fracture, in the large proportion of the cases, is assured when opportunity is given, but also that positive treatment of the fracture is the most conservative treatment of the patient.

Paradoxical as it may seem, the plaster spica, which has always borne the brunt of the adverse criticism of the method, has proved to be the most effective means of fulfilling what was considered "the first consideration, to save life" by relieving pain and preventing bedsores and hypostatic congestion, the most dangerous complications of the injury. Successful results in the eighth and ninth decades of life have become commonplace and one such case has been reported in a patient aged 102.

Finally, the anatomical method, which is effective both in reducing resistant deformity at the base and in adjusting displaced fragments of the neck proper, is equally comprehensive in its practicability. Since it requires neither elaborate apparatus for its application nor the cooperation of skilled nursing, it has proved effective under the hard conditions of domestic practice, even in inexperienced hands.

The spiking operation, with which the abduction method is often contrasted to its disadvantage, dates from preabduction days when it was considered the only means of fixing the fragments. It was revived in recent years by Smith-Petersen on the logical proposition that, since the capacity for repair of the transcervical fracture had been so amply demonstrated, the percentage of failure might be materially reduced by open exposure, accurate adjustment of the fragments, and secure fixation by his flanged nail.

The open operation has now been displaced by the indirect method, introduced by Johansson, in which, after the fragments have been adjusted by abduction mechanics, the flanged nail is inserted through a small incision at the base of the trochanter. Thus, since this method

must utilize anatomical mechanics to appose the fragments, it may be classed as a complement to the abduction treatment, substituting artificial for natural splinting. It has the advantage over the open operation in its comparative freedom from danger, and the percentage of union is materially higher because of less interference with nutrition. Its most attractive feature from the standpoint of the patient is comparative freedom from restraint: "In a few hours the patient is ready for a wheeled chair and may at once, if so disposed, enjoy the use of crutches." This introduces the question of function as influenced by treatment.

The essentials of a normal gait are a sufficient range of abduction and extension. Even after the limb has been fixed for weeks in extension and abduction, it has been found necessary to carry out in the after-care a routine of what the patients call "stretching" in these directions, until voluntary control has been restored.

From this personal experience it may be questioned if the flanged nail will so suppress the sensitiveness of the injured part as to permit locomotion, weight-bearing, and the habitual assumption of the sitting posture during the period of repair and yet check the tendency toward flexion and adduction so characteristic of injury or disease at the hip joint.

The purpose of this final paper is set forth in its title. The fact that what was formerly the most neglected of all fractures can now command the technical skill required for the spiking operation is conclusive evidence that the campaign which has been carried on for upwards of half a century has been successfully concluded.

A CLINICAL AND ANATOMICAL STUDY OF THE SEMIMEMBRANOSUS BURSA IN RELATION TO POPLITEAL CYST *

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The purpose of this communication is to report the results of a study of the condition variously designated as "popliteal cyst", "popliteal bursitis", and "Baker's cyst". Our curiosity about this condition was aroused by observing, during operations for the removal of such cysts, that the sac always appeared at the same site in the popliteal space and bore a uniform relationship to certain anatomical structures, and further, that, although the cysts invariably communicated with the joint cavity and were subjected to considerable pressure, they did not empty as might be expected, but remained distended with fluid. We undertook, therefore, to review the literature dealing with the subject, to collect and to study our case material, and to make such anatomical studies as might be indicated in order to give a better understanding of the condition.

LITERATURE

The literature contains several references to cysts of the popliteal region. Adams, in 1840, described a tumor of this region due to an enlargement of the bursa under the medial head of the gastrocnemius. He stated that this bursa communicated with the knee "by a species of valvular opening" and concluded that the enlargement was the result of arthritis of the joint. Gruber studied the anatomy of enlarged bursae and of true posterior herniae of the knee joint, publishing papers in 1845, 1869, and 1885. Foucher, in 1856, presented eleven dissected specimens of popliteal cyst and nineteen clinical cases and supported the theory that these most commonly resulted from distention of bursae, particularly the bursa under the inner head of the gastrocnemius. Baker, in 1877, described eight cases of swelling of the popliteal space. In a second paper, in 1885, he added two more cases. Also included in this second paper were six cases of a similar condition in other joints. In his first paper, Baker concluded that these popliteal cysts were herniae caused by the effusion in the knee joint due to osteo-arthritis. In the second paper, enlargement of a normal bursa was added as a possible etiological factor. Several of the cysts which he described contained pus, and one gains the impression that they were in reality cold abscesses. Hawkes, in 1899, reported four cases of enlargement with inflammation of the bursa gastrocnemio-semimembranosa. Hémet stated in 1900 that the chief site of origin of these cysts was the bursa between the gastrocnemius and the semimembranosus. Among the writers presenting single cases of interest may be mentioned Cravener, in 1932, and Snodgrass in 1936. Haggart,

* Read at the Annual Meeting of the American Orthopaedic Association, Atlantic City, New Jersey, May 3, 1938.

in a recent article, stated: "Posterior hernia of the knee joint or hyperplasia of an adjacent bursa is the cause of a synovial cyst in the popliteal space." Often cases of popliteal cyst in which he has operated during the past four years, he concluded that nine were true posterior herniae and one was due to enlargement of the semimembranosus bursa.

ANATOMY OF THE POSTEROMEDIAL BURSAE OF THE KNEE

The anatomy of the bursae about the knee joint was studied in a number of recognized anatomical textbooks, including those by Gray, Callander, Piersol, Spalteholz, and Cunningham, and, in addition, thirty dissections of the popliteal fossa and the medial side of the knee joint were performed on cadavera. The anatomy of these bursae is variously described by the different authors, and it appears to us that the discrepancies are the result of variations in the degree of fusion or lack of fusion between various members of what we may term the six primary bursae (Fig. 1). These are:

1. A bursa between the tendons of insertion of the sartorius, the gracilis, and the semitendinosus on the one hand and the tibial collateral ligament of the knee joint on the other.

2. A bursa between the tibial collateral ligament and the tendon of insertion of the semimembranosus (a semimembranosus bursa).

3. A bursa between the tendon of the semimembranosus and the medial condyle of the tibia (a semimembranosus bursa).

4. A bursa between the medial head of the gastrocnemius and the capsule over the inner condyle of the femur.

5. A bursa between the superficial surface of the inner head of the gastrocnemius and the overlying semimembranosus and extending downward and medially between the tendon of that muscle and the capsule over the medial condyle in its lower part (a semimembranosus bursa).

6. An occasional bursa, according to Gray, between the semimembranosus and the semitendinosus.

Designating these by the numerals on the above list, the first (*1*) is universally recognized. The two bursae (*2* and *3*) surrounding the tendon of the semimembranosus, close to its insertion, are frequently described as one when they freely communicate. The last bursa (*6*), appears to be of infrequent occurrence, and this leaves us with the two remaining bursae (*4* and *5*) which seem to be of chief clinical significance. These are accepted as frequently coalescing to form one bursa. Gray describes the bursa under the inner head of the gastrocnemius as having a prolongation superficially between the posterior surface of this muscle and the tendon of the semimembranosus: he does not mention a separate bursa between these two muscles. Piersol describes this composite bursa in greater detail: "the largest (bursa in the popliteal region) is between the internal head of the gastrocnemius and the semimembranosus and the inner condyle of the femur, extending downwards to the inner tibial tuberosity and even as low as the upper margin of the popliteus".

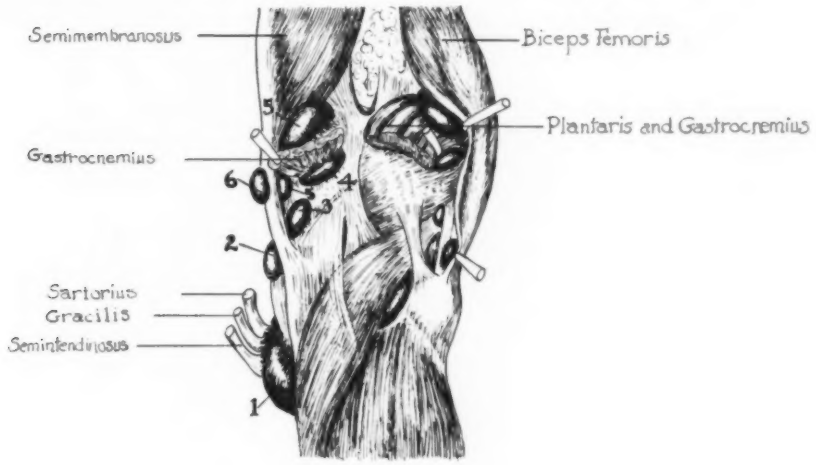

FIG. 1

Right popliteal space, showing bursae. (Modified from Callander.)

Spalteholz explains the confusion over the term semimembranosus bursa: "Bursa m. semimembranosi, constant, double; one between the m. semimembranosus and caput mediale m. gastrocnemii, in front coming in contact with the capsule of the joint (it may communicate with the joint); the other, between the tendon of the m. semimembranosus and the condylus medialis tibiae." These comprise in our list *5* and *3*, the latter frequently communicating with *2*. The frequency with which the bursa under the inner head of the gastrocnemius communicates with the joint is estimated by Foucher and Gruber (quoted by Piersol) as 50 per cent. or more of the cases. All the authorities readily agree that this bursa frequently communicates, although some (Piersol, Morris) add some reference to adult life.

Through the courtesy of the Department of Anatomy of Columbia University, we were able to dissect the popliteal fossae of thirty cadavera in order to study these bursae in connection with the semimembranosus and the inner head of the gastrocnemius. In twenty-six cases, we found this composite bursa which we may call the gastrocnemio-semimembranosus bursa. This presented very superficially between these two muscles and sometimes was in contact with the deep fascia of the popliteal space (Fig. 2). The irregular, lax, superficial portion was approximately one to one and one-half inches long and one-quarter of an inch across, with its long axis corresponding with the outer border of the semimembranosus. This part was loosely attached to the fatty areolar tissue intervening between the deep fascia, the tendon, and the muscle. The deeper part of the bursa was intimately attached to the tendon of the semimembranosus and to that of the inner head of the gastrocnemius, for the under surface of this latter muscle was tendinous where it overlay the capsule over the upper part of the medial condyle of the femur. The

FIG. 2

Superficial view of anatomy of gastrocnemio-semimembranosus bursa.

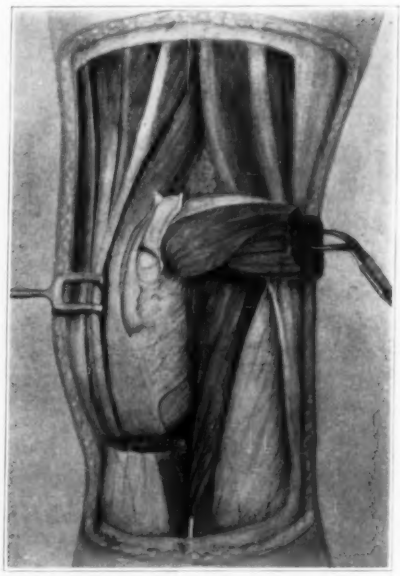

FIG. 3

Deep view of anatomy of gastrocnemio-semimembranosus bursa, showing inner head of gastrocnemius cut inferiorly and retracted upward. The bursa is laid open and is seen to be adherent to the two muscles and to the capsule. The communication with the knee joint is seen at the upper extremity of the bursa.

proximal portion of the bursa was usually found to extend around the inner border of the origin of the inner head of the gastrocnemius, covering it superficially as well to about one-quarter of its width. Distally, the bursa reached the inner tuberosity of the tibia. In tracing it transversely, the bursa invested the contiguous margins of the two muscles, spreading over their deep surfaces, and was then reflected onto the capsule of the knee joint. In its lower third the bursa also lined and was adherent to the superficial surface of the tendon of the semimembranosus. When the inner head of the gastrocnemius was cut inferiorly and the upper portion was elevated (Fig. 3), it was seen that the bursa was not closely adherent to the more muscular lower part of the under surface of the gastrocnemius, but it became detached and bridged the interval between the elevated muscle and the posterior capsule of the joint, to which it was firmly attached. The portion of this bursa passing downward, forward, and inward under the tendon of the semimembranosus came near to the bursae surrounding this tendon at its insertion (*2* and *3*), but in the material dissected no communication was found. The bursa frequently showed septa, apparently representing its composite origin. In four cases, there were two separate bursae,—one the semimembranosus bursa (*5* in the list), and the other the bursa under the inner head of the gastrocnemius (*4*). When the septum was incised, the two bursae together were found to have the

relations described for the gastrocnemio-semimembranosus bursa, the septum passing across from the capsule medially to the deep surface of the inner head of the gastrocnemius within a few millimeters of its inner border. The septum took a relatively oblique course in passing from the anterior to the posterior wall of the composite bursa, so that it lay almost in the coronal plane.

Out of the thirty specimens dissected, all of which were in adult cadavera, we found communication with the joint in seventeen, two of these being communications with the independent bursa under the inner head of the gastrocnemius. The semimembranosus component, when separate, was never found to communicate with the joint, and the communication was always located in that part of the composite bursa contributed by the bursa under the inner head of the gastrocnemius. It was found high up under the origin of the inner head of the gastrocnemius, above and medial to the oblique popliteal ligament, and was rarely smaller than one-half an inch in diameter. There was, of course, no neck or stalk, as the anterior wall through which the communication occurred consisted only of the posterior capsule lined with synovial mesothelium on one surface and bursal mesothelium on the other. The edges were greatly attenuated, and, since the color of the smooth bursa-covered capsule was almost identical with that of the condylar cartilage, the perforation was not always recognized until the knee was flexed and the capsule was induced to separate from the subjacent condyle. The situation of this gastrocnemio-semimembranosus bursa in relation to the bones is illustrated in the roent-

FIG. 4-A

FIG. 4-B

Roentgenograms of left knee of cadaver with gastrocnemio-semimembranosus bursa injected with paraffin and lipiodol.

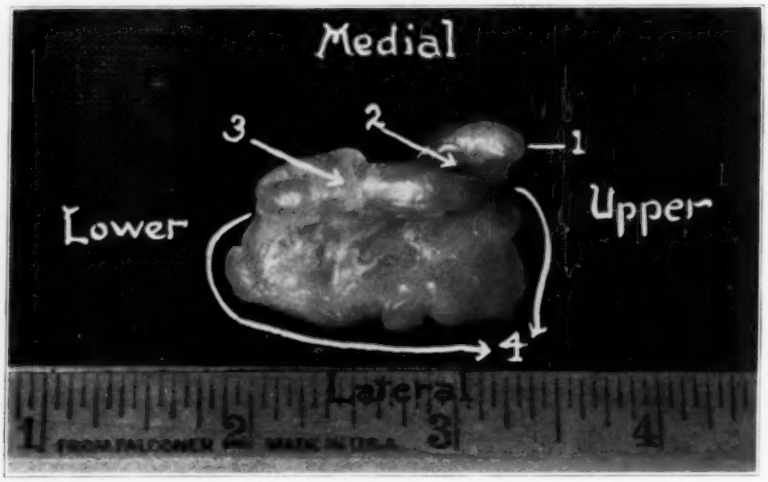

FIG. 5-A

Cast of right gastrocnemio-semimembranosus bursa. Posterior or superficial view.

1: Portion of bursa medial to semimembranosus tendon.
2: Groove for semimembranosus tendon.
3: Superficial portion of bursa appearing between semimembranosus and inner head of gastrocnemius.
4: Part covered by inner head of gastrocnemius.
5: Area of communication with knee joint bounded below by *6*.
6: Groove formed by capsular edge.
7: Portion of bursa in contact with capsule.

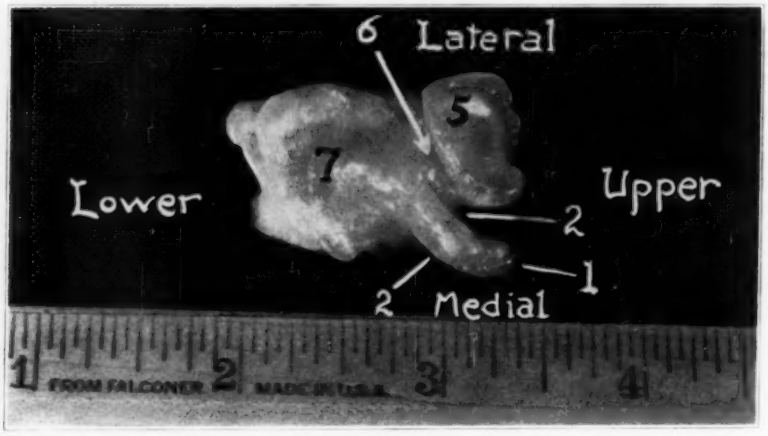

FIG. 5-B

Cast of right gastrocnemio-semimembranosus bursa. Anterior or deep view.

genograms (Figs. 4-A and 4-B) made when the bursa in a cadaver was injected with a mixture of lipiodol and paraffin. The paraffin casts were dissected out and photographed. Two (Figs. 5-A, 5-B, 6-A, and 6-B) are illustrated here and show the grooves for the semimembranosus tendon and the medial head of the gastrocnemius. In one (Figs. 5-A and 5-B),

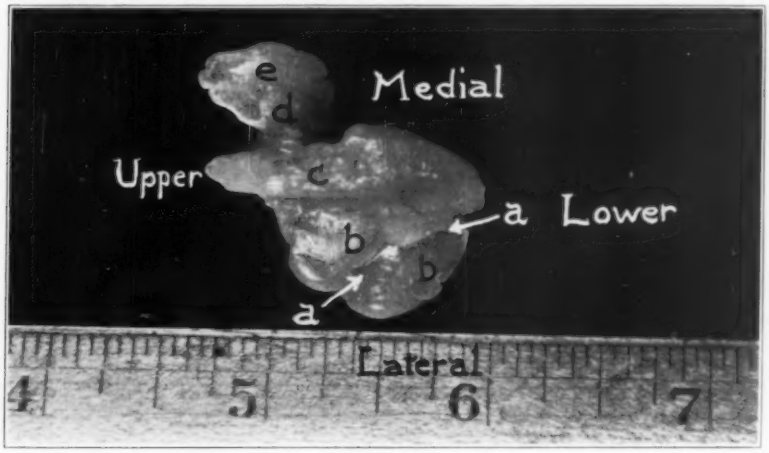

FIG. 6-A

Cast of left gastrocnemio-semimembranosus bursa to show pronounced septum. Superficial view.

a: Septum incompletely dividing the bursa with its component primary parts.
b: Portion covered by inner head of gastrocnemius.
c: Superficial portion of bursa.
d: Groove for tendon of semimembranosus.
e: Portion of bursa medial to tendon.
f: Deep surface in contact with capsule.

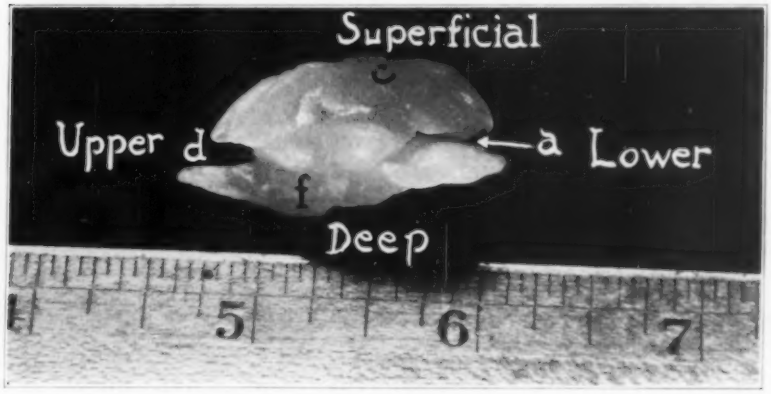

FIG. 6-B

Cast of left gastrocnemio-semimembranosus bursa to show pronounced septum. Lateral view.

the communication with the knee joint is well shown, and in the other (Figs. 6-A and 6-B), the presence of the septa is clearly evident.

REVIEW OF THE CLINICAL MATERIAL

A search of the records of the Hospital for the Ruptured and Crippled revealed that between the years 1926 and 1938 twenty-one patients had been subjected to operation with the diagnosis of popliteal cyst. (See Table I.)

TABLE I

ANALYSIS OF TWENTY-ONE CASES IN WHICH OPERATION WAS PERFORMED FOR POPLITEAL CYST BETWEEN 1926 AND 1938

Patient	Sex	Age (*Years*)	Side	Complaints	Effusion in Knee	Roentgeno-graphic Report	Date of Operation	Communi-cation with Knee Joint	Anatomy of Cyst	End Results
E. F.	Male	32	Left	Knee and cyst			February 1926	Yes	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	
D. D.	Male	10	Left	Cyst			September 1926	Yes	Medial: Inner head of gastrocnemius Lateral: Outer head of gastrocnemius	
I. V.	Male	45	Right	Knee and cyst			September 1929	Yes	Medial: Lateral: Inner head of gastrocnemius	
D. K.	Male	4	Right	Cyst			February 1930	?	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	
A. S.	Female	14	Left	Cyst			March 1930	?	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	
R. B.	Female	65	Right	Knee and cyst		Osteo-arthritis	January 1931	No	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	No recurrence. No complaints.
E. S.	Male	33	Right	Cyst			January 1933			
L. C.	Male	6	Right	Cyst			June 1933			No recurrence. Some aching in knee.
I. A.	Male	39	Left	Knee and cyst	Present	Osteo-arthritis	July 1934	Yes	Medial: Semitendinosus Lateral: Inner head of gastrocnemius	
Same Patient			Right	Knee and cyst	Present	Osteo-arthritis	January 1935	Yes	Medial: Lateral: Inner head of gastrocnemius	

A. L. B.	Female	50	Left	Knee and cyst	None	Osteo-arthritis	May 1935	Yes	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	No recurrence. Some aching in knee.
M. G.	Female	64	Left	Knee and cyst	Present	Osteo-arthritis	January 1936	Yes	Medial: Semimembranosus Lateral: Gastrocnemius	No recurrence. Both knees cause complaints.
D. O'L.	Male	53	Right	Cyst	None	Normal	September 1936		"From region of inner condyle"	
P. V.	Male	5	Right	Cyst	None		September 1936	No	"Originated from semimembranosus bursa"	
S. d'A.	Male	57	Left	Knee and cyst		Osteo-arthritis	February 1937	Yes		
S. K.	Male	37	Left	Knee and cyst			April 1937	Yes	Medial aspect of popliteal space	No recurrence. No complaints.
F. I.	Male	47	Right	Knee and cyst	Present	Charcot's knee	April 1937	Yes	Medial aspect of popliteal space	No recurrence. Brace for unstable knee.
E. B.	Female	49	Left	Knee and cyst	None		September 1937	Yes		No recurrence. Knee fairly comfortable.
T. S.	Female	60	Right	Knee and cyst	None	Normal	November 1937	Yes	Medial: Semimembranosus and semitendinosus Lateral: Gastrocnemius	Recurrence.
R. P.	Female	62	Right	Knee and cyst	None	Normal	February 1938	Yes	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	
A. V.	Male	5½	Right	Cyst	None	Normal	March 1938	Yes	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	
L. W.	Male	73	Right	Knee and cyst	Present	Osteo-arthritis	April 1938	Yes	Medial: Semimembranosus Lateral: Inner head of gastrocnemius	

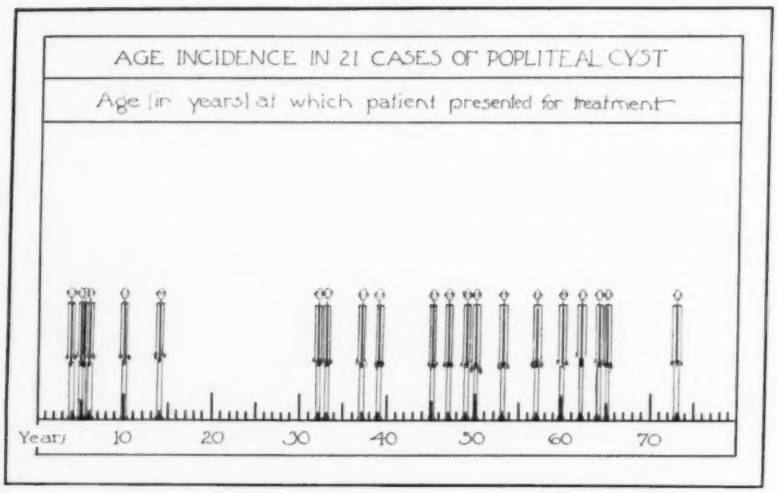

FIG. 7

Age incidence in twenty-one cases of popliteal cyst.

The age incidence is shown in Figure 7. Twenty-nine per cent. of the patients were in the first fifteen years of life; in the next fifteen years there was no case; and subsequently each decade provided an equal quota until the seventies were reached. A study of the sex incidence in this series showed that the male predominated in the ratio of two to one. There was no marked preference for either knee, and the condition was bilateral in only one case, that of a man with severe osteo-arthritis of the knee. In the children's group, the only symptom seemed to be the swelling itself with an occasional complaint of some apparent weakness or sparing of the affected limb. In none of these cases, apart from the discovery of the cyst itself, was there any positive clinical finding in con-

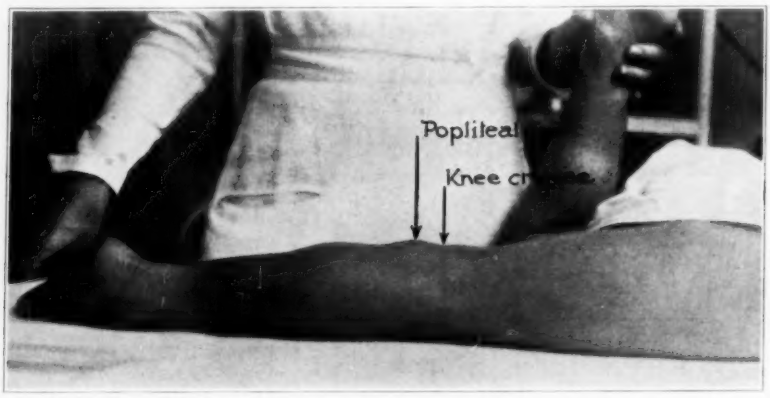

FIG. 8

Clinical photograph showing popliteal cyst lying just distal to posterior knee crease.

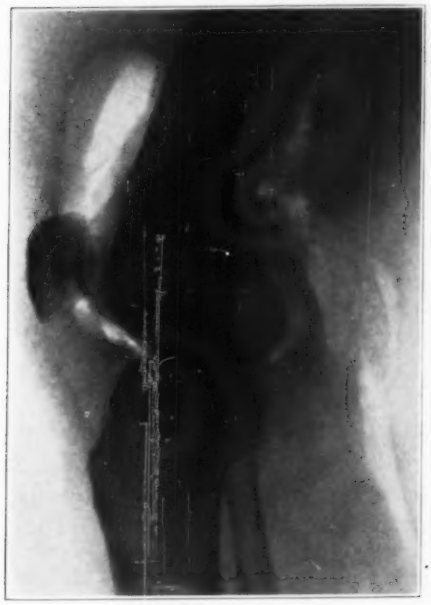

FIG. 9-A

Case R. P. Roentgenogram (lateral view) of right knee showing pneumarthrosis resulting from aspiration and air injection of communicating popliteal cyst.

FIG. 9-B

Case R. P. Anteroposterior view of right knee.

nection with the joint. In the adult group, the symptoms were referred to the posterior aspect of the knee and the popliteal fossa in two cases and to the whole knee in thirteen cases. In no case had the patient noticed the cyst longer than two years. In regard to the physical signs, the ease with which the cyst could be recognized varied tremendously. In some cases, on extending the knee, it was readily evident as a firm cystic swelling emerging between the muscles on the posteromedial surface, while in others it formed a lax cystic mass presenting so indefinitely as to be almost imperceptible in the fatty substance of the popliteal fossa.

In our last three cases we adopted a technique of aspirating the cyst and injecting it with air, holding the knee in slight flexion. The communication with the knee joint was demonstrated in two of the cases when a pneumarthrosis was shown in the roentgenograms (Figs. 9-A and 9-B). In the third case, that of a child, although the cyst was filled with air and a communication with the joint was demonstrated at operation, the air did not enter the joint. Cravener injected air directly into the knee, but this procedure seems to us less likely to demonstrate a communication when the opening is small. In the adult cases in which there was a notation in the histories as to whether or not the knee showed an effusion, it was present in five out of ten knees, one case being bilateral. The roentgenographic examination showed definite evidence of osteo-arthritis in seven out of eleven adult knees in which such examination was recorded, one case presenting the picture of a Charcot's knee. In only three cases

did we note the relation of the cyst to the popliteal skin crease, and in these it was slightly distal to the skin crease, a point brought out by Haggart. (See Figure 8.)

OPERATIVE FINDINGS

In describing the operative findings, we will first give a résumé of the operative notes concerning the patients in this series, many of whom were operated upon before we began our study of this condition. We will later describe in detail our own operative findings which have been uniform in all of the seven knees operated upon by us personally. A definite communication between the cyst and the knee joint was found in fifteen knees; in two there was no communication found; and in five there remained a doubt or there was no record on this point. The cyst appeared between the inner head of the gastrocnemius and the semimembranosus in thirteen knees; in one, it was described as "originating from the semimembranosus bursa"; in two, as appearing from the inner aspect of the popliteal space; in one, from the region of the medial condyle; and in another, from between the two heads of the gastrocnemius. In four cases, the record was too vague to be of value.

In our own operations, which, unless contra-indicated were performed with the aid of a tourniquet, a curved incision, about six inches long and convex medially, was made centering over the cyst. The curved incision has the advantage of avoiding a straight scar at the back of the knee, which is often slow in healing and tends to keloid formation. The skin and subcutaneous fascia were dissected back, and the deep fascia was exposed. This was divided longitudinally, and immediately the tense cyst, which was flattened beneath the unyielding fascia, came into view. (See Figure 10-A.) It was sometimes covered with a variable amount of fatty areolar tissue. By sharp dissection, a plane of cleavage was found, and the cyst was freed until it was clearly seen to pass between the inner head of the gastrocnemius and the still fleshy belly of the semimembranosus. The tendon of the semitendinosus, passing superficial to the semimembranosus, lay in medial relationship to the cyst. The cyst wall was next dissected away from its attachment to the semimembranosus and the inner head of the gastrocnemius. There was no plane of cleavage here, and it was necessary to resect a portion of the tendinous covering of the gastrocnemius muscle and a thin superficial layer of the semimembranosus along with the cyst wall if rupture was to be avoided. (See Figure 10-B.) The cyst was found to be compressed between the two muscles when the knee was extended, so that moderate flexion of the knee rendered this part of the dissection easier.

The cyst was then opened and inspected from inside, and it was found to be adherent to the deep surface of the inner head of the gastrocnemius, passing laterally to at least half its width. (See Figure 10-C.) From here it was reflected onto the posterior capsule to which it was equally adherent over an area sometimes as much as two inches square.

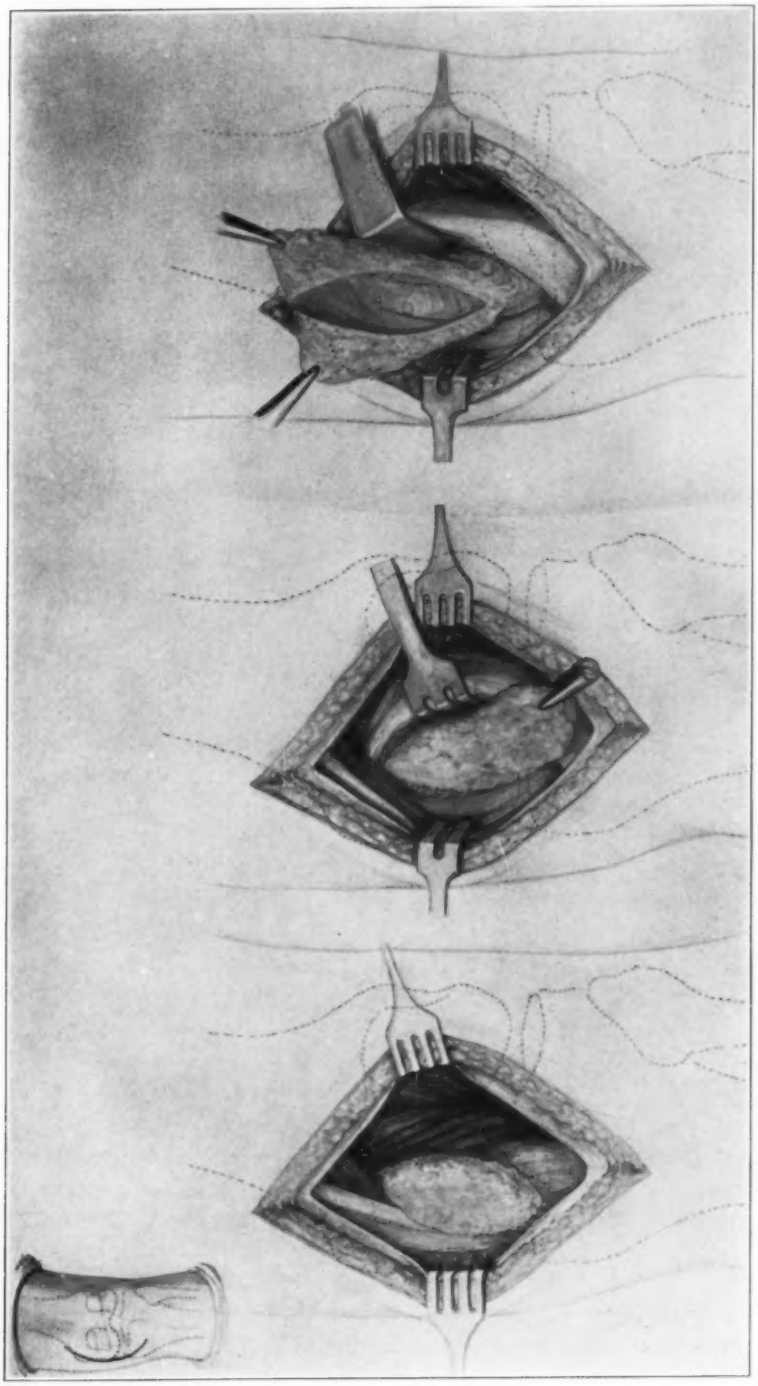

FIG. 10-A FIG. 10-B FIG. 10-C

Typical operative findings:

Fig. 10-A: Exposure after incision of deep fascia.
Fig. 10-B: Separation of adherent cyst from semimembranosus and inner head of gastrocnemius.
Fig. 10-C: Cyst turned up and incised. Interior shows communication with knee joint and intimate contact of deep portion of cyst with capsule, tendon of semimembranosus, and deep surface of inner head of gastrocnemius.

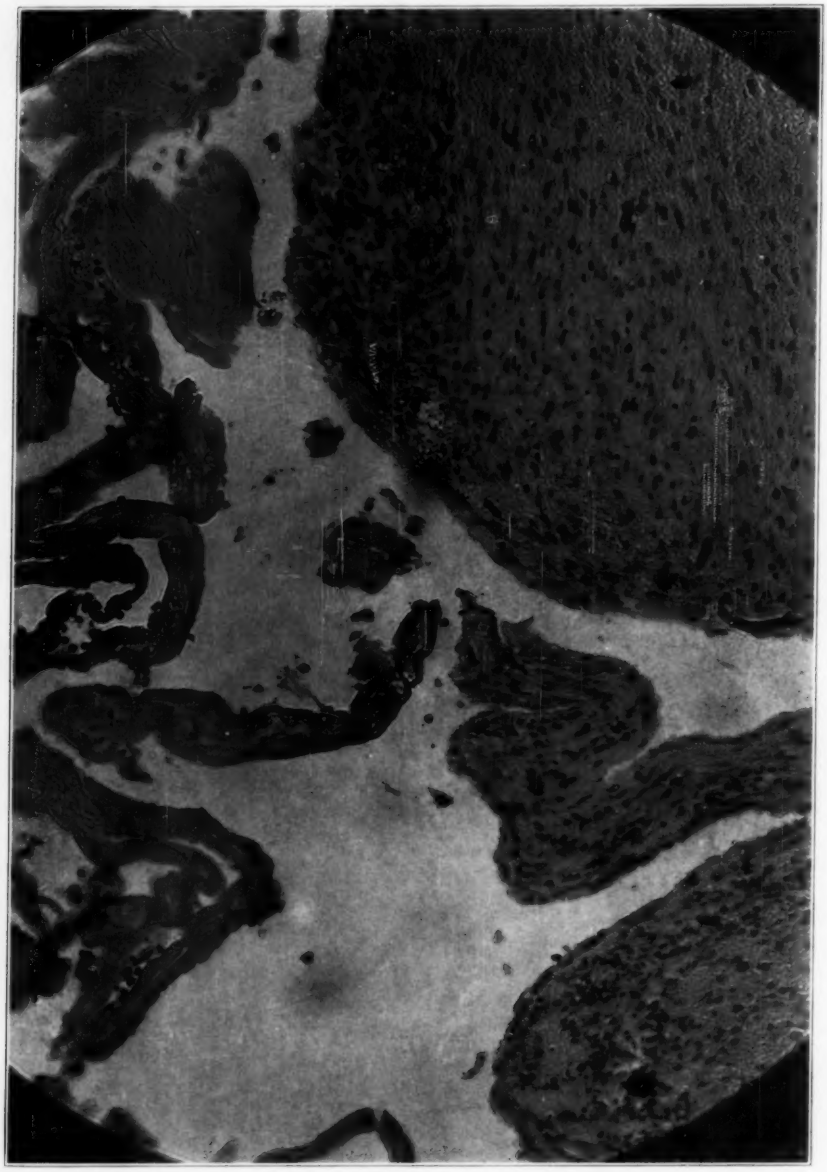

FIG. 11

Photomicrograph (×100) showing inner lining of popliteal cyst composed of loose fibrous tissue. There is a surface layer of mesothelium. The hyaline material lies on the surface and has been traced to degenerated cartilage.

The deeper part of the cyst, intimately blended to these tendons and the capsule, usually appeared small in comparison with the remainder of the cyst and might be described as the neck of the cyst. When the cyst was smaller, this fixed deeper portion was found to form a relatively larger portion of the cyst. The communication with the joint was found

proximally under the inner head of the gastrocnemius and close to the origin of this muscle. In relation to the joint, the opening lay near the upper part of the posterior articular surface of the medial condyle of the femur. It might be covered by a membranous fold. In one child we found a definite septum, suggesting the origin of the cyst from the two primary bursae. The communication was always found to be smaller than that seen in our anatomical dissections.

The anatomy of the deeper part having thus been closely studied from within, the removal was completed by dissecting the cyst from those structures to which it was adherent. The inner head of the gastrocnemius, retracted strongly laterally, acts as a useful barrier between the field of operation and the important neurovascular structures placed more centrally in the popliteal fossa. The perforation in the capsule through which the cyst communicated with the knee joint was sutured when this could be accomplished with ease. This was not always the case, as the capsule was frequently taut and the edges could not be approximated. In this series, closure was effected in eight out of the fifteen cases in which a communication existed. The tourniquet was then removed and hemostasis obtained. The deep fascia was sutured, followed by closure of the subcutaneous layer and the skin. A compression bandage over an adequate layer of rolled sheet cotton completed the dressing, no splint being used.

The postoperative treatment consisted of rest with the leg elevated for the first three days. The compression bandage was released after twenty-four hours, unless this had been done previously on account of discomfort. Elderly patients were encouraged to sit up in bed and to engage in minor activities to avoid hypostasis, and many were allowed up in wheelchairs as early as the second day. Setting exercises of the quadriceps were started on the fourth day and continued until full function of the knee and of the quadriceps muscle had been restored. Sutures were removed on the tenth day when the patient was allowed up, wearing an ace bandage. The patient was usually discharged about the twelfth day. Complications consisted of moderate postoperative effusion in two cases, in neither of them sufficient to cause discomfort, and the breaking down of a keloid scar three months after operation in one case, later requiring excision and resuture.

PATHOLOGY

Through the cooperation of Dr. D. A. DeSanto, Pathologist of the Hospital for the Ruptured and Crippled, detailed pathological studies of specimens obtained from eighteen knees were made. On gross examination, the cyst wall varied in thickness from one-fourth to one-thirty-second of an inch; the fluid within was viscid, and frequently contained fibrin. The inner lining was generally smooth, but in areas might be slightly roughened, due to adherent hyaline material. The outer surface was usually irregular and showed adherent fibro-fatty and areolar tissue. Sections showed a fibrous wall lined with flattened mesothelium (Fig. 11). The wall was for the most part flat, but was sometimes

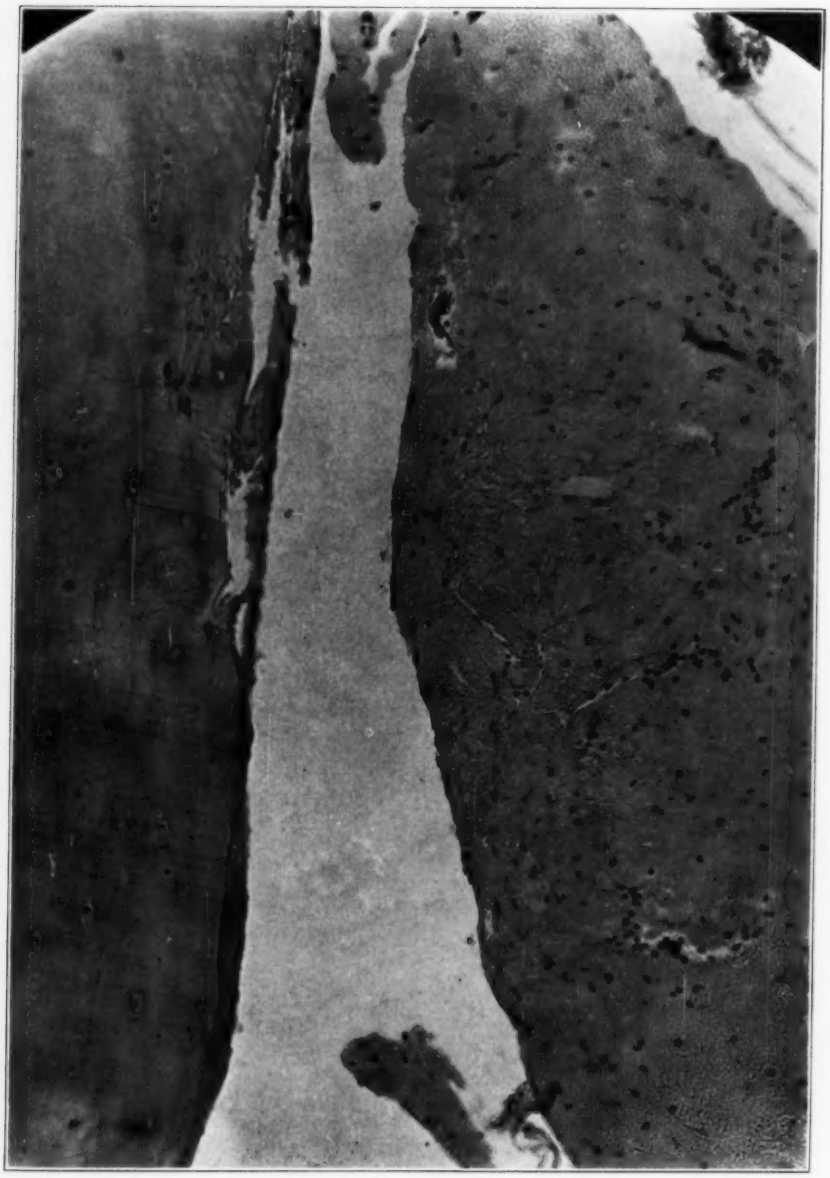

FIG. 12

Photomicrograph (×100) showing a portion of a wall of a popliteal cyst with areas of hyaline and fibrocartilage.

arranged in vascular papillary folds resembling synovia. In places the lining surface was covered with an adherent hyaline exudate. The connective tissue was for the most part highly cellular in character, showing numerous proliferating fibroblasts and areas of lymphocytic infiltration. The outer portions of the cyst wall consisted of fibro-fatty tissue and

contained medium-sized blood vessels. In the majority of the adult cases metaplasia into hyaline cartilage and fibrocartilage was observed in certain areas of the cyst wall (Fig. 12). In two cases (one of which was the case of Charcot's arthropathy), osteoid tissue and bone were found. In one case, in a child, primitive cartilage cells were present in the wall of the cyst. At least one-quarter of the cases showed clumps of intracellular hemosiderin pigment.

END RESULTS

We have been able to obtain end-result examinations in only eight cases; the remainder of the patients either have been operated upon within the last three months or have not been located. One patient, a child of eleven years, who was operated upon five years previously, complained of occasional aching in the knee after a day's exertion. Physical examination showed perfect function of the knee and it was noted that the complaint in no way interfered with games or other activities. In the patient with Charcot's arthropathy of the knee, the benefit obtained from treatment appeared to have resulted more from the use of the caliper brace than from the excision of the popliteal cyst. In another patient, a woman of sixty, who had been operated upon only six months previously, a small recurrent cyst appeared to have developed in the same situation,—namely, the medial part of the popliteal fossa. At operation the cyst, which showed moderate hyperplasia of the surface layer of its lining, was found to be typical of a distended gastrocnemio-semimembranosus bursa and communicated with the knee joint. An attempt was made to close the opening in the capsule with a silk stitch, but the approximation of the edges was unsatisfactory. The recurrence was confirmed by aspiration and injection of air, which proved that there was a small deep cyst communicating with the joint. The remaining five patients were relieved of all posterior discomfort and complained only of "rheumatic" aches proportionate to the osteo-arthritic changes present in the knee.

DISCUSSION

Our study, based upon a review of the clinical and operative findings in twenty-one cases and anatomical dissections in thirty cadavera, has convinced us that popliteal cysts are, if not invariably, at least in the great majority of instances fluid distentions of the gastrocnemio-semimembranosus bursa. The arguments that support this view are, first, the almost invariable origin of the cyst from between the inner head of the gastrocnemius muscle on the one hand and the tendons of the semitendinosus and the semimembranosus muscles on the other, a situation which corresponds to that of the bursa. Excluding the four cases in which the operative description was inadequate, this relationship was noted in fourteen cases. In one case, the cyst was described as arising from the region of the medial condyle, which would correspond with the location of the bursa. In two others, it was stated to have originated from the inner side of the popliteal space; and in one other, from between the two heads of the

gastrocnemius muscle. We are inclined to question the accuracy of this last description, since the semimembranosus muscle has a fleshy belly extending downward to a point about two inches above its insertion, which, in the case of displacement of the inner head of the gastrocnemius laterally by a large cyst and of a limited exposure, might easily be mistaken for the gastrocnemius muscle.

The second point is the almost invariable finding at operation of an intimate attachment between the medial and the lateral walls of the deeper part of the cyst and the tendinous portions both of the gastrocnemius and of the semimembranosus muscles. So intimate is this fusion that it is necessary to resect a portion of the muscle or tendon along with the cyst wall if one is to avoid tearing it. This fact has been constantly mentioned in the operative notes and has been our invariable personal observation. Even Haggart, who supported the theory of herniation and described most of the cysts operated upon by him as originating from between the two heads of the gastrocnemius muscle, mentioned this finding. Our dissections of the gastrocnemio-semimembranosus bursa invariably revealed a similar intimate blending of the bursal walls and the adjacent surfaces of the muscles. (See Figures 13-A and 13-B.) Such an intimate attachment is characteristic of a bursal structure present from birth and destined to permit gliding action of these structures, and it is quite different from what would be expected with an adventitious hernial protrusion which would displace structures ahead of it.

The position of the opening in the posterior capsule communicating between the cyst and the knee joint, high up behind the medial condyle, also corresponds to the position of the opening between the bursal cavity and the knee joint. Such a communication is not invariably present either in the cyst or in the normal bursa. It was demonstrated in fifteen of the twenty-two cysts that were excised and was found in seventeen of the thirty anatomical specimens that were dissected. It would be easy to overlook such an opening at operation on account of its situation high up under the origin of the inner head of the gastrocnemius muscle and its attenuated margins, which blend almost imperceptibly with the small exposed portion of the articular cartilage.

The theory of origin of the cyst as a hernial protrusion must surely postulate increased intra-articular pressure, due to chronic joint effusion, as a cause, yet six of our twenty-one patients were children in whom there had never been any effusion and whose knees appeared perfectly normal except for the cysts. One would not expect a hernial protrusion of the joint capsule in a child and would consider either a congenital deviation of a normal structure or a ganglion as more likely causes. The operative findings in these cases ruled out ganglia, because of the nature of the fluid contents, the frequent communication with the joint, and the size of the tumor, and we believe they can be best explained as bursal distentions. Although gross effusion in the knee joint played a prominent part in a certain proportion of the adult patients with cysts, its complete absence in

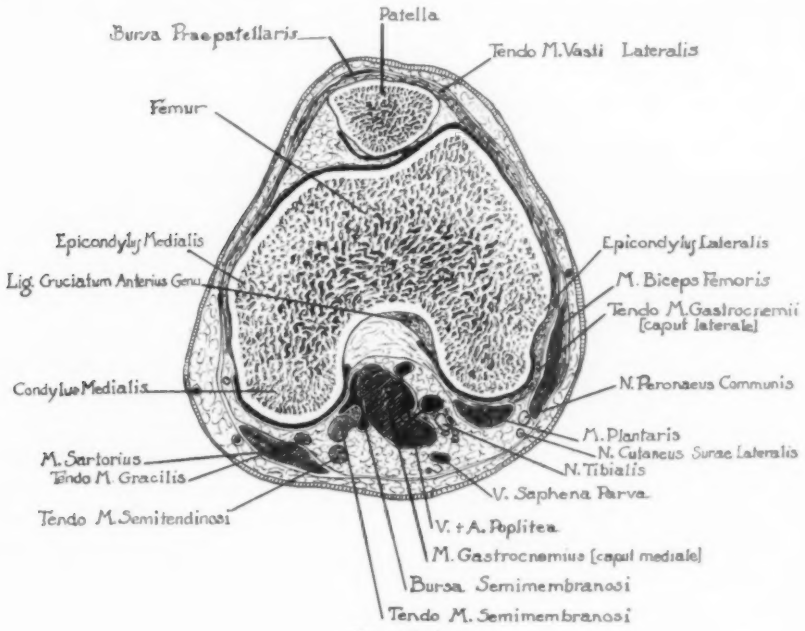

FIG. 13-A

Cross-section at level of knee, showing gastrocnemio-semimembranosus bursa.

many others precludes it from playing an essential rôle in the etiology. Should considerable effusion and intra-articular pressure play an important part in any one case, would they not act in distending a communicating bursa with its unsupported walls rather than expending themselves in producing a fresh pouch in better supported areas of the capsule?

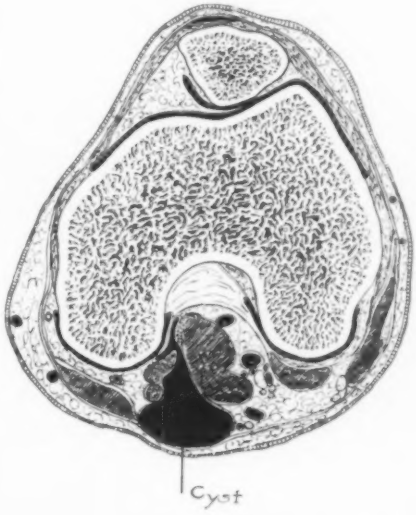

FIG. 13-B

Cross-section at level of knee, showing popliteal cyst.

An interesting question in respect to these cysts is why they remain distended with fluid in spite of a communication in most instances with the knee joint. A few of the patients did in fact notice the rather sudden disappearance of the swelling at the back of the knee and its reappearance only after considerable intervals of time. We have one patient under observation at present in whom a cyst was demonstrated by aspiration of fluid, after which the swelling disappeared and remained absent for two

years. We tried to empty some of the cysts by pressure, but without success except in one instance at operation after the cyst was freed. Yet when air was injected into the cyst it passed promptly into the knee joint. This behavior suggests a valve-like action at the mouth of the cyst. The only explanations we can suggest are that either the close application of the communication to the femoral condyle permits the latter to act as an obturator in the opening, or the close approximation of the gastrocnemius and the semimembranosus muscles compresses the deeper portion of the sac sufficiently to shut off the fluid in the more superficial part. In this connection, it should also be remembered that the fluid is often viscid and the opening itself is small.

There remains to be considered the cause of these effusions in the gastrocnemio-semimembranosus bursa. We can find no evidence to support a theory of infectious or toxic origin and are forced to conclude that they are due to trauma of the bursa, either in the form of repeated small injuries from the vigorous contraction of the muscles which in part help to form its walls or from a single violent movement which actually tears a part of the wall. The frequent finding of blood pigment in the wall of the cyst on microscopic examination lends support to this theory. The sequence of events would appear to be traumatic irritation of the bursa followed by effusion. When the bursal sac becomes even moderately distended, it is then subject to repeated irritation from movements of the knee and use of the muscles. A process of chronic inflammation is then set up, which leads to gradual thickening of the wall of the sac with metaplasia of the reparative elements into cartilage, as was so frequently found on microscopic examination of the excised specimens, and occasionally into bone. Congenital aberration in the structure of the bursa may well play a part in the process, particularly in the case of children.

Finally, we would suggest that the various bursae at the posterior aspect of the knee, and particularly the large gastrocnemio-semimembranosus bursa, are probably of greater clinical importance than has yet been realized. Inflammation in these bursae may offer an explanation of many complaints of vague pain at the back of the knee. Confirmation of such a diagnosis may readily be obtained by aspiration, especially of the gastrocnemio-semimembranosus bursa, which can be easily located. The latter bursa, which so often communicates with the knee joint, must be frequently involved in septic arthritis of the knee and also in tuberculosis and may offer an easy pathway for extension of the infection into the popliteal space. It should be investigated either by palpation or by aspiration in all such cases.

There remains the question of treatment of a popliteal cyst. Should it be removed? It is in all cases likely to give rise to symptoms *per se*, and in most instances it is prone to cause irritation of the knee through extension of the inflammatory process along the lining membrane and the slow discharge into the knee of the somewhat irritating fluid in the cyst. While aspiration may yield temporary relief, we believe that permanent

relief can be obtained only by excision of the cyst. The operation is unlikely to cause any serious complication, and we believe that it is indicated in almost all cases. Recurrence of the cyst after thorough excision is rare.

SUMMARY AND CONCLUSIONS

1. The large gastrocnemio-semimembranosus bursa appeared in twenty-six out of thirty dissections. In four, we found two bursae,—one under the inner head of the gastrocnemius, and one between this muscle and the semimembranosus.

2. The composite gastrocnemio-semimembranosus bursa communicated with the knee joint in fifteen out of these twenty-six dissections; the bursa under the inner head of the gastrocnemius communicated with the joint in two out of the four cases in which there were two separate bursae; while the bursa between the inner head of the gastrocnemius and the semimembranosus was never found to communicate directly with the joint.

3. Thirteen out of fourteen cysts in the medial portion of the popliteal space, the anatomy of which was recorded in detail in the operative notes, appeared between the semimembranosus tendon and the inner head of the gastrocnemius.

4. The cysts were adherent to part of the tendinous surfaces of these two muscles in a manner similar to that found in the semimembranosus bursa.

5. Cysts were found in children and in adults and appeared similar in the two groups.

6. An effusion in the knee joint was present in only five out of ten cases in which this point was referred to in the preoperative note.

7. Our studies lead us to conclude that most, if not all, popliteal cysts are the result of fluid distention of the gastrocnemio-semimembranosus bursa.

8. We believe that the cysts result from injury to the bursal wall caused by muscle contractions followed by effusion.

9. Microscopic examination of the cyst walls showed blood pigment frequently present, also fibrous thickening and cartilaginous and osteoid metaplasia.

10. Operative excision of the cyst appears to be the best treatment.

11. The various bursae at the back of the knee, and particularly the large gastrocnemio-semimembranosus bursa, would seem to have greater clinical importance than has yet been realized.

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GAS-BACILLUS INFECTION AS A COMPLICATION OF FRACTURES

BY DAVID M. BOSWORTH, M.D., NEW YORK, N. Y.

From the Traumatic Service of the New York Polyclinic Medical School and Hospital

HISTORY

The results of infection with bacillus welchii and associated organisms were probably first reported by Hippocrates. A massive amount of investigation and work has been done on the subject since that time. In 1749, Quesnay described the subcutaneous emphysema, and Velpeau, in 1839, noted its frequent occurrence in compound fractures. De Bazas, in 1836, analyzed the gas found in the tissues, noted its inflammability, and demonstrated the presence of hydrogen sulphide as the most prominent component. Maisonneuve is probably the most quoted early worker along these lines. In 1853, he gave the condition the name of "*gangrène foudroyante*". While many writers reported innumerable cases of gas-infected wounds during the major European wars, Keen, during the American Civil War, recorded not a single case. Welch isolated the organism bearing his name; Pasteur, the vibrion septique; and Koch and Novy, the bacillus oedematiens. It has been reported that 2 per cent. of all wounds sustained by the American Expeditionary Force were infected with gas and that 48.52 per cent. of these patients died. In view of all recent reports, this stands out as one of the major tragedies of the World War, for, in 1930, Larson and Pulford reported seven cases, in all of which the gas infection was controlled with serum which they used unrefined and in amounts up to 1000 cubic centimeters. One of the patients died, but many days after the control of the gas bacillus and from streptococcic infection. The most noteworthy fact was that *amputations were not done.* Apparently this report has been overlooked or its importance has been minimized, for the mortality of two other reported series in 1935 and 1936, treated with serum plus amputation, has remained about 15 per cent. Then, in 1936, Kelly and Dowell reported a series of cases, all of which were treated by x-ray therapy and all except seven with serum. In this series, 45 per cent. of the patients who also had amputations died, while none of the patients who had no amputations died.

BACTERIOLOGY

One of the most rational reports on the bacteriology of these infections and the establishment of diagnosis was made by Reeves. He pointed out that of the seven spore-forming anaerobes pathological for man, clostridium welchii was found in 79 per cent. of the cases of gas-infected war wounds, and in 14 per cent. it was the only organism. Vibrion septique was also frequently present, but clostridium oedema-

tiens, clostridium histolyticum, and clostridium fallax were rare. Although they are rare, Ghormley stresses the need of investigating cases of infection similar to gas infection having oedema only. He had one fatality, with clostridium oedematiens as the only organism. In retrospect, the author feels sure that he missed one similar case in which the patient died. Reeves also discounts inoculation of rabbit and guinea-pig liver with destruction of the animal and incubation of the body for the presence of gas and organisms in the liver as a rapid means of identification of these bacteria. He holds that capsule-stain tests for bacillus welchii or cultural methods for the other organisms must be done to establish definitely their presence. It is almost universally conceded that the presence of gas in cases of amputation done in old people for arteriosclerosis or diabetes is due not to bacillus welchii and associated organisms, but to other organisms always present in aged or devitalized living tissue prior to amputation.

PATHOLOGY

The differentiation between true gas-bacillus infection and the gas infections of amputation stumps in old or diabetic patients is further confirmation of the pathological changes found. In the former, no line of demarcation is present and the infection spreads rapidly and without limitation in muscles and under fascial planes; whereas in the latter, a true line of demarcation always forms if a terminal event does not occur. Liver change is a common finding in late cases associated with jaundice. The swelling of involved muscle tissue and liquefaction with gas production have been frequently described. It is noteworthy that discolored, dark, distended, or even partially liquefied muscles are not always dead.

DIAGNOSIS

While the odor cannot be relied upon, since it is inconstantly present, still these patients present a peculiar clinical picture which if once seen is likely to be recalled. One should always be in a suspicious frame of mind when dealing with fractures which are compound or have been compound at any time and in which repair is taking place. The fact that the wounds are healed is no guarantee that a massive bone graft or even the removal of metallic fixation may not stir up a latent infection dormant in the tissues. In each case the most outstanding impression has been of a very sick patient, slightly disoriented, complaining of great pain if asked, but otherwise lying quietly with a flushed face, very rapid pulse, and no great temperature. The patient is evidently sick and toxic way beyond the bounds indicated by temperature alone. Many years ago such a case was seen under the care of another physician and went to fatal termination before proper diagnosis was made. The clinical picture of that case so impressed us that in all subsequent cases we have readily made a correct clinical diagnosis. Percussion of the skin anywhere near the wound area will give a tympanites and palpation crepitus. If the patient is seen

early, little if any discoloration will be noted. The wound will be drier than usual and the underlying tissues will have a doughy consistency, tending to bulge through the skin opening. Roentgenographic examination will show gas in the soft structures, but to be positive must show an increase in the amount of gas over an interval of time. Compound fractures or operations frequently permit a certain amount of subcutaneous emphysema and roentgenograms under these circumstances will show the same or a diminished amount of gas. A smear from the wound, anaerobic inoculation, animal-liver injection and incubation, capsule stain, and the beginning of cultural identification should be immediately undertaken.

TREATMENT

There is no question that prophylaxis in the form of tetanus *and gas* antiserum should be used in every case of compound fracture. The reason that our series is no larger, covering as it has Fracture Services in seven hospitals, is undoubtedly due to the fact that this rule has been uniformly established. One patient with a compound fracture failed to get gas serum but did get tetanus antiserum and within fourteen hours a severe gas-bacillus infection of the wound developed. Curative serum therapy should be commenced with clinical diagnosis, for bacteriological confirmation will take time and the loss of even three or four hours is important. We have used twenty-cubic-centimeter doses of refined polyvalent serum intravenously every two hours until the gas infection was under control. Since no statistics are available and this dosage seemed adequate, we have established this as a standard for ourselves. No intramuscular serum has been used. In operative cases drainage through the original operative wound is usually sufficient, but if only a compound wound is present, it should be enlarged through the skin and fascial planes with due regard for vessels and nerves. Débridement or removal of masses of muscle should be avoided. Intramuscular planes should be opened in areas of greatest infection if possible, but unnecessary destructive surgery should not be done. Muscle which appears to be dead, if let alone, will frequently be found viable at a later date. Transfusions are necessary, especially in those cases complicated by clostridium histolyticum. In our series, continued or repeated massive infusions of glucose and saline were routinely used. Support of the part in metal splints with continuous moist dressings to encourage drainage is important. The kind of fluid used for irrigation or moistening of dressings is relatively unimportant. It is evident that peroxide, potassium permanganate, etc., cannot reach all infected areas. Amputation is senseless and harmful, and all reports to date will bear this out. We have an agency which will destroy the infection where it lies,—namely, serum. X-ray therapy can be questioned from many angles, but the fact remains that seven patients in one series, without serum or amputation or any known specific medication, all recovered with x-ray therapy and that none in that same series, treated by x-ray alone, died. One can argue that bacteriological reports

on these cases are lacking, but it is impossible to conceive that in all of them there was failure of proper diagnosis. Most, if not all, must have been cases of true gas-bacillus infection. Until further work has been done along these lines, the writer would not advise reliance on x-ray therapy alone, but he does feel that it should be used as an adjuvant to serum therapy.

CASE REPORTS

CASE 1. I. S. An operation for removal of a Parham band and graft of the humerus was done on January 6, 1937. Granulation tissue found around the Parham band was not cultured. Severe gas-bacillus infection, involving the arm, the upper forearm, and the chest wall, was discovered in thirty-six hours. The patient had pneumonia, not proved to be due to bacillus welchii. The presence of bacillus welchii was proved by cultures taken from the wound. The operative wound only was opened, and twenty cubic centimeters of refined polyvalent serum was given intravenously every two hours after desensitization. A total of 400 cubic centimeters, or 400,000 units, was given with 1000 cubic centimeters of blood and 6500 cubic centimeters of glucose intravenously within thirty-six hours, at which time the infection was entirely under control, the temperature was down, and the patient was rational. Severe serum sickness developed in seven days. A cast and Orr dressings were applied at the end of three weeks, with bacillus welchii present by culture in the wound and without any reaction whatever. Under successive Orr dressings the wound healed and the graft was sequestrated as in any osteomyelitic case. Biopsy and removal of the scar of the healed wound fourteen months later showed bacillus welchii still present in the deep tissue, although the scar was soft, pliable, and freely movable on the underlying tissues.

CASE 2. A. B. On October 1, 1936, the patient suffered the following injuries: on the left—fractures of the femur, the middle third of the radius, the lower third of the radius (Colles), the carpal navicular, the ankle (Potts), the tarsals with dislocation, and a compound fracture of the middle third of the tibia; on the right—fractures of the clavicle and the scapula, fracture of the pelvis with separation of the symphysis pubis; and rupture of the urethra. A protective dose of bacillus welchii serum was given on admission, but five days later a mild bacillus welchii infection, culturally proved, developed in the wound which had been left open. This infection was easily controlled with four intravenous administrations of twenty cubic centimeters of serum, 80,000 units in all. The patient's reaction to the gas infection was mild and, therefore, difficult to determine clinically when the case was under control. Twenty four days after fracture, Orr dressings and casts were applied without any reaction referable to the gas bacillus probably still present in the wound. The compound lesion healed uneventfully; all of the other fractures united; and the patient is without disability except for deformity due to the fracture-dislocation of the left foot.

CASE 3. R. J. By error, gas-bacillus serum was not given on this patient's admission on January 18, 1937, for a compound fracture of the right tibia. Within fourteen hours he had a moderately severe gas-bacillus infection of the entire right leg, proved by cultural methods. The skin of the calf was split longitudinally on the inner and outer sides, and moist dressings were applied. He received 110,000 units of polyvalent bacillus welchii serum intravenously within thirty hours, with two transfusions of 500 cubic centimeters each. By that time, without other treatment, the gas-bacillus infection was entirely controlled. A moderate serum sickness developed a week later. Sixteen days after injury, casts and Orr dressings were applied without any reaction from the bacillus welchii still present, and healing and solid union took place as in any other compound fracture similarly treated. Bacillus welchii was proved by culture to be still present in the wound four weeks following the application of the first closed dressing and cast. There was no clinical evidence of gas infection in the tissues at that time.

CONCLUSIONS

1. Prophylaxis with both gas and tetanus antiserum should be the rule in all cases of compound fracture.

2. Amputation should never be done for acute gas-bacillus infection, although it may later be necessary because of deformity.

3. Repeated massive doses of intravenous polyvalent serum should be continued until the gas-bacillus infection is controlled.

4. Drainage but not débridement should be instituted. Many tissues first thought to be dead will later be found viable.

5. X-ray therapy may yet prove to be of the greatest help.

6. Orr dressings and treatment may be safely carried out as in any other infection of bone, once the acute gas infection has been brought under control, without regard to the presence of bacillus welchii and its associates which remain lying apparently inert in the wound.

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BACKACHE

A Manipulative Treatment without Anaesthesia * †

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In the course of the development of a particular medical thought, when the literature promises to become voluminous, one sometimes suspects that the particular thought is not so clear. In a rather paradoxical manner, the more numerous and detailed the studies become, the less of actual fact do we ferret out. The literature on the subject of low-back pain, voluminous in the past, lately has been given added impetus. One feels, however, that, unlike many other problems, the growing literature on this problem is not indicative of how little is known on the subject, but how rapidly its various ramifications are becoming increasingly clarified.

There are perhaps few other symptoms in medicine which, because of the multiplicity of the etiological possibilities, offer a greater problem so far as differential diagnosis is concerned. A consolidated area of lung tissue becomes manifest through inspection, palpation, percussion, and auscultation. Here we appreciate the symptom of pain and understand its causation. On the other hand, when the patient complains of pain for which there is apparently no immediate clear-cut background of disturbed anatomy, we are left with a problem of pathological physiology whose source may be near or remote and which, at the exodus of the patient, with all other active physiological manifestations disappears from the inquirer's search.

Low-back pain is becoming more clearly recognized as a subject of multiple aspects, arising from multiple causes, and it is, therefore, a more intriguing therapeutic problem because of the many facets which it presents. Methods of treatment have been multiplied and diversified. At the present time, we are at least equipped to attack the problem on a number of fronts: on the anatomical side, from anomalies and discrepancies of bone relationship; on the static physiological side, from the standpoint of poor body mechanics; on the kinetic side, from the aspect of trauma and sprain of the muscles and ligaments and of joint subluxation; from the general pathological aspects of suppurative arthritis, tuberculosis, malignancy, etc.; and from the neuropathological aspects of cord pressure from prolapsed discs, tumors, and hypertrophied elements.

The form of treatment which the author proposes to discuss in its

* Read at the Annual Meeting of the American Academy of Orthopaedic Surgeons, Los Angeles, California, January 19, 1938.

† This communication, when originally presented, was illustrated with a 700-foot motion-picture film demonstrating the manipulative procedures. This film is available upon request.

application to low-back conditions cannot be regarded as new. Up to the present, however, it has been consigned to the outer regions of therapy and regarded as unorthodox. Because of its nature, its use is restricted to a particular group of low-back conditions. In its employment, therefore, the differential diagnosis of low-back conditions becomes of the utmost importance. An accurate history of the patient—including a detailed family account, habits, environmental and occupational influences, and, most important, a regional survey with cardiac, respiratory, gastro-intestinal, and genito-urinary investigations—will supply information which will immediately exclude many possibilities of a symptomatic nature. The physical examination should include a detailed examination of the back. Roentgenograms should be taken to verify the examiner's impressions or conclusions. All frank pathological lesions of the back will have been excluded.

We are, therefore, concerning ourselves not so much with those conditions of the low back which are made obvious from the history or whose true nature is immediately disclosed by roentgenograms, but, rather, with those conditions of low-back pain whose pathological background is indifferent or indeterminate so far as a correct allocation of the cause of the pain is concerned. Such conditions include the anatomical variations (sacralization, impinging transverse processes, etc.), congenital anomalies, poor posture (contraction of the tensor fasciae latae, marked lordosis, etc.), dislocations (apophyseal subluxation, spondylolisthesis, etc.), fasciitis and myofascial syndromes, and sprains (acute or chronic) of traumatic etiology. It is the author's opinion that in all of the foregoing conditions, the element of sprain plays an important rôle,—whether it has been the result either of a direct traumatic incident or, because of impaired body mechanics, of a kind of trauma active over an extended period of time.

Searching analyses of these conditions from different points of view have been appearing from time to time. Kendall, of Baltimore, has contended that imbalanced foot muscles may inaugurate the low-back syndrome, the pronated foot and internally rotated femur giving rise to secondary contraction of the internal rotator muscles of the hip (including the tensor fasciae latae) and of the sacrospinalis muscles.

Reasoning somewhat in the reverse direction, Ober considers the contracted tensor fasciae latae as the precipitating or primary factor in the syndrome rather than one of the resultant conditions. While these two observers have approached the facts along different avenues of thought, nevertheless both observations are of value in the treatment of low-back conditions and will be considered in more detail in the following pages.

Pitkin and Pheasant, in a series of five articles, have analyzed the various aspects of low-back pain with scoliosis or list and sciatic irritation under the caption "sacrarthrogenetic telalgia". Their conclusions are stimulating and some are as follows:

CHART I

Routine Examination Chart

Name: Address:
Occupation: Age: Referred by:
Chief Complaint: Duration: Onset: Attacks:

Physical Examination:

I. Inspection:

Standing posture:

A. Posterior view: List: Homolateral Contralateral Alternating
Scoliosis: Thoracic Shoulders: right
Lumbar Sacrospinalis left
Gluteal crease: Relaxation Atrophy
Position of posterior superior spine

B. Lateral view: Chest { flat / elevated } Back { round / straight }
Lordosis Abdomen

C. Anterior view: Shoulder girdle rotated to Pelvis rotated to
Position of anterior superior spine Rotation of femora
Pronated feet

Leg Measurements:

Actual (anterior superior spine to internal malleolus)	right	left	Apparent (umbilicus to internal malleolus)	right	left
Calf	right	left	Thigh	right	left

II. Palpation:

Palpable tenderness:

Iliolumbar:	right	left	Lumbosacral:	right	left
Sacro-iliac:	right	left	Sacrotuberous:	right	left
Piriformis:	right	left	Sciatic nerve:	right	left
Sacro-ischial:	right	left	Interspinous ligaments:	right	left
Vertebral spines:	right	left			

III. Active Movements:

Standing:
Forward flexion: Lateral left Lateral right
Hyperextension: Rotary left Rotary right
Sitting:
Forward flexion:
Supine:
Straight-leg raising right left

IV. Passive Movements (Special Tests):

Pressure on iliac crests and symphysis pubis:
LaGuere's Gaenslen's Ely's right left
Ober's abduction right left

V. Neurological:
Knee jerks Ankle jerks Babinski Saddle anaesthesia

VI. Significant Laboratory Work:

VII. X-Ray:

VIII. General Remarks:

"Pathological changes in the tension of, or irritative stimuli applied to, the extra-articular ligaments of the upper sacral joints cause telalgia in the lower extremities."

"Sacro-iliac mobility can be demonstrated *in vivo* by measuring the movements of the ilia."

"Abnormal sacro-iliac mobility is a potent cause of the abnormal ligamentous tension that produces sacrarthrogenetic telalgia."

In a more recent communication, Steindler, describing the posterior-division syndrome, has shown by means of his procaine hydrochloride test that "both local pain and radiation are in causal connection and that radiation may be elicited by an area of local pain as a reflex symptom without being caused by root compression".

PHYSICAL EXAMINATION

The physical examination is carried out on the premise that the low-back pain in question is the result of sprain or injury to the ligamentous apparatus, including the secondary reactions of the musculature and nerve irritation. The standing posture of the patient is observed in its various aspects. There may be either no list or a very slight one, or the patient may be locked in a position of flexion deformity by severe muscle spasm. Under palpation, an attempt is made to localize exactly the site of pain and of tenderness. Whether one is prone to think of low-back pain in the horizontal terms of lumbosacral and sacro-iliac strain, or in the vertical terms of anterior-division and posterior-division syndromes, the Smith-Petersen routine of back examination is of considerable value in further localizing the disability. The various tests—including straight-leg raising, Gaenslen's, Ober's abduction test, Ely's test, etc.—are also routinely employed. The form which the author has found useful in recording the data obtained at examination is shown as Chart I.

TREATMENT

Sprains involving joints vary in severity from marked stretching to actual tearing of capsule and ligaments, with certain degrees of subluxation. In order to be successful, therefore, the therapy for such conditions must adequately anticipate the extent of the pathology. In brief, the accepted treatment of sprain is: rest by means of immobilization, local applications for accelerating circulatory response, and sufficient time to allow the injured tissue to heal. Some types of sprain, for instance that of the ankle, do well on this regime. Given a sprain involving a deeper joint, however, with marked muscle spasm and some degree of deformity, the carrying out of this routine of immediate immobilization and prolonged rest may afford little correction or relief. Rather more logically, in such cases one would be prone to manipulate gently the involved joint, in order to correct whatever degree of malalignment or subluxation may have occurred incident to the tearing or stretching of the ligaments or capsule. In this manner, the normal relations of the joint are restored, the torn soft tissues are more correctly approximated, and the muscle spasm is more effectively and permanently allayed.

Instances of this sort are frequently demonstrated in injuries to the

cervical region of the spine. Reference is made particularly to those types of injuries to the neck, which, in spite of seemingly negative roentgenograms, present a definite clinical picture of sprain or subluxation. There is not only debilitating, persistent pain, but muscle spasm and the asymmetrical pattern of torticollis or wryneck are also present. Even in this region, a very definite list is noted with lateral inclination of the head on the neck and varying degrees of rotation, as well as impairment of motion or actual locking. Immobilization of the part in this particular position might serve to preserve the deformity and prolong the pain. The incidence of this type of injury is steadily increasing in direct proportion to the incidence of automobile mishaps. Condemned as it were by negative roentgenograms, very often such patients wander through many hands until they are finally consigned to the diagnostic category of neurotics or malingerers. Periodic sessions of steady traction and gentle manipulative manoeuvers without anaesthesia, but under a state of self-induced relaxation, have resulted in the successful restoration of normal cervical alignment, with the attitude of the head properly related to the neck, and the obliteration of the painful and deforming muscle spasm. Then heat and prolonged rest are found to be more effective therapeutic aids. The advent and development of laminography engenders the hope that in the near future the actual status of these lesions may be more definitely defined and their true clinical nature more accurately appraised.

One thinks of manipulating the deeper joints with a certain amount of trepidation. Why we do not hesitate to manipulate superficial joints, such as a subluxated shoulder, and yet withhold entirely from manipulating a deeper joint, such as the very important sacro-iliac, is difficult to understand.

Confronted time and again with these cases of acute low-back pain only to have the standardized methods of treatment fail, it seemed entirely reasonable to suppose that manipulation might correct whatever possible malalignment had been brought about. The manipulative technique for the treatment of low-back conditions which Baer developed some twenty years ago required the administration of an anaesthetic. Since many of these cases require more than one manipulation, the problem of repeated administration of anaesthesia had to be considered. Again, such a technique as could be carried out effectively without anaesthesia would certainly have a more practical place in the emergency treatment of low-back sprain.

CONTRA-INDICATIONS

In reviewing the hundreds of cases that comprise this series, it is especially notable that very few contra-indications have been encountered. In discussing the subject of contra-indications, one presupposes satisfactory relaxation of the patient and a manipulative technique that is neither rough nor unduly forceful. Strength should not be mistaken for skill. If these conditions do not obtain, it is quite likely that undesirable

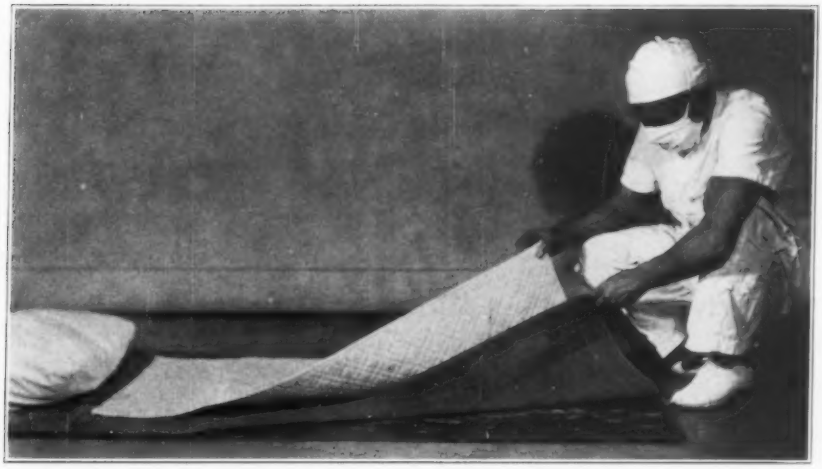

FIG. 1

The pad used for manipulation has a non-skid rubber base and a smooth leather cover, on top of which is placed a thin cotton pad plus a pillow.

and even dangerous results may ensue. Patients with chronic low-back pain should never be manipulated until they are adequately examined and the general condition fully appraised by means of a complete investigation. In this way, such definite contra-indications as fracture, neoplasm, tuberculosis, suppurative arthritis, advanced rarefaction secondary to hyperparathyroidism, etc., are ruled out and avoided. Uncompensated cardiac cases, of course, constitute a definite risk. Patients with inguinal hernia may be handled carefully and without undue danger.

PREPARATION OF PATIENT

The manipulation is carried out with the patient lying not on a table but on the floor. In order to ensure adequate purchase in gripping the shoulder, ilium, etc., the patient is completely unclothed. Likewise, to prevent the mat from slipping on the floor, a sponge-rubber base (Fig. 1) is first laid down, and upon this the leather mat and the cloth mat are

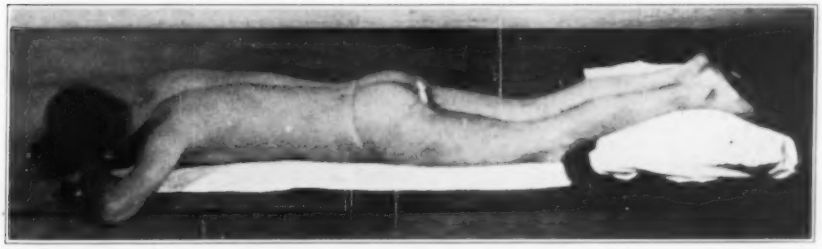

FIG. 2

The patient lies prone with the hamstrings relaxed, due to the fact that the legs and feet are slightly elevated over a pillow. Complete relaxation is essential to effective manipulation.

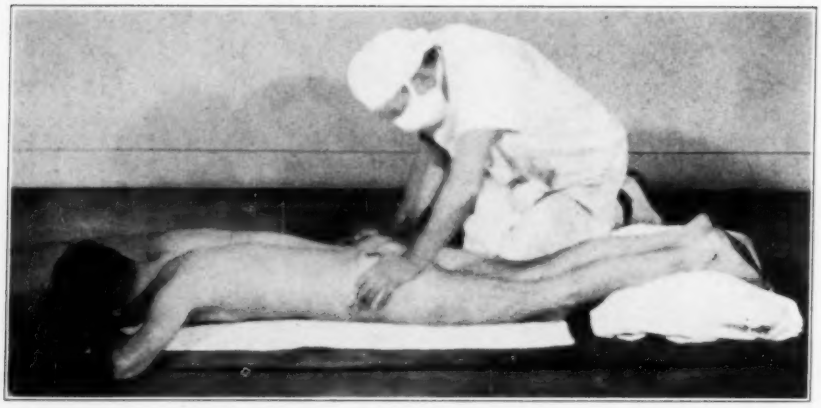

FIG. 3

Demonstrating the deep kneading massage of the gluteal muscles.

placed in turn. Very often these patients are in such acute pain that standing and moving are extremely difficult. For these reasons, they are taught how to get down to the floor properly, thereby saving themselves further muscle spasm or strain. By bending the knee on the well side and resting both hands on it, they gradually bring the affected knee down to the floor, followed then by the good knee. Once down upon both knees they then lean forward on their hands, in the knee-hand position. By flexing the elbow and bringing the trunk forward, the knees are gradually extended, the trunk is gently lowered to the floor, and the prone position is thus assumed. (See Figure 2.)

A survey of the patient in this prone position makes quite evident most of the deformities observed in the weight-bearing erect attitude,—the list (whether homolateral or contralateral), the spastic sacrospinalis muscles, and the very evident general rigidity of the patient. The sites

FIG. 4

Showing extent of massage over sacrospinalis muscles up to and including the shoulder girdle.

FIG. 5

Showing the position for Manoeuver 1 of the actual manipulation. The ilium is thrust forward and downward; the shoulder is rotated backward. (Flexes left sacro-iliac joint and stretches posterior sacro-iliac ligament. Some rotary movement to lumbosacral joint.)

of tenderness—whether in the lumbosacral, iliolumbar, or sacro-iliac regions, or in the gluteal or piriformis muscles, or in the ligaments—are still quite positive.

For this reason, massage of the gluteal muscles (Fig. 3) is begun carefully and gently, the patient meanwhile being induced to relax as completely as possible. When the pelvis begins to roll more easily from side to side with the gentle massage, the deeper kneading, which eventually includes the areas of tenderness and pain, is begun. From the pelvis, the

FIG. 6

Manoeuver 2—reverse of Manoeuver 1. (Extends left sacro-iliac joint and stretches anterior sacro-iliac ligament; also rotates lumbosacral joint in opposite direction to Manoeuver 1.)

course of massage proceeds to the paravertebral areas (Fig. 4) and finally to the mid-thoracic region, so that the shoulder girdles are likewise brought into a state of as complete relaxation as is possible. This procedure is eminently successful in securing satisfactory preliminary relaxation in most cases. The greater part of its success depends upon the intelligent cooperation of the patient, since such relaxation at this time is largely self-induced. However, during the course of the manipulation, it will be noted that a more complete state of relaxation very definitely results from particular manoeuvers, and it is undoubtedly enhanced by the disappearance of the painful spasm of the affected sacrospinalis muscles.

THE MANIPULATION

Manoeuver 1

The patient is taken from the prone position, following deep muscle massage, and is placed on his right side. The right knee and hip are extended fully. The left knee and hip are flexed. The left hand is placed over the left pectoral region. This position is arranged by the manipulator. Next the manipulator with his left hand grasps the left ilium firmly in the region of the anterior superior spine and holds the left shoulder with his right hand. He then executes a rotary or torsion movement, bringing the patient's shoulder backward and at the same time thrusting the ilium forward and downward (Fig. 5).

Discussion: An important phase of this particular movement is a sudden and prolonged downward and forward thrust to the ilium, which very often results in a snapping sound, at times relatively prolonged, which simulates the tearing apart of sheets of fly paper. This movement tends to shift the left ilium forward or to flex it on the sacrum, separating the posterior margins of the left sacro-iliac joint and therefore tensing and stretching especially the left posterior sacro-iliac ligament. The left iliolumbar ligament likewise is stretched because of the opposing movements of trunk and pelvis. This latter movement is responsible for a simultaneous rotary movement of the interlaminar joints of the lower thoracic and all of the lumbar vertebrae as well as of the lumbosacral joint.

Manoeuver 2

The patient maintains the position as in Manoeuver 1. The manipulator then reverses the movement bringing the shoulder forward and thrusting the left ilium backward and upward (Fig. 6).

Discussion: This manoeuver has a tendency to separate the anterior margins of the left sacro-iliac joint and to stretch, therefore, the left anterior sacro-iliac ligaments. The rotation and mobilization of the lower thoracic and lumbar interlaminar joints and of the lumbosacral joint are now in the opposite direction. Relaxation of the sacrospinalis group very often occurs at this time with beginning correction of the list.

Résumé: In these two manoeuvers, the left sacro-iliac joint has been primarily mobilized with secondary mobilization of the lower thoracic, lumbar, and lumbosacral interlaminar joints and of the lumbosacral joint.

Manoeuvers 3 and 4

The position of the patient is now reversed. He is taken from the attitude of resting on his right side and placed on his left side. The left knee and hip are extended fully, and the right knee and hip are flexed. The right hand is placed over the right pectoral region. The manipulator executes the torsion or rotary movement already described and then follows with its reverse.

FIG. 7-A

FIG. 7-B

Manoeuvers 5 and 6—hyperextension of thighs: first with the fulcrum on the ilium; second, with the fulcrum on the sacrum. In many cases, the fulcrum on the sacrum creates much more pain than when it is on the ilium. (Primarily stretches iliotibial bands; secondarily rotates sacro-iliac joints clockwise on sacrum.)

FIG. 8-B

FIG. 8-A

Manoeuver 7—passive flexion of spine at lumbosacral level, plus rotation of pelvis with spine in acute flexion. (Flexion and rotation of lumbosacral joint; stretching of sacrospinalis muscles.)

FIG. 9-B

FIG. 9-A

Same procedure as shown in Figs. 8-A and 8-B, using canvas strap when patient's weight is too much for lone manipulator to manage.

Discussion: These manoeuvers tend to separate the anterior and posterior margins of the right sacro-iliac joint, thereby stretching the associated anterior and posterior sacro-iliac ligaments. The rotary movement of the lower thoracic, lumbar, and lumbosacral interlaminar articulations is

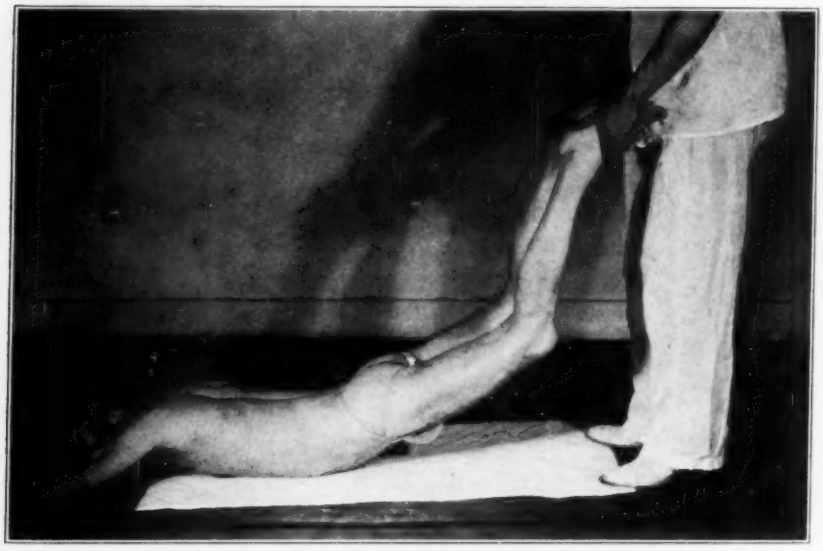

FIG. 10-A

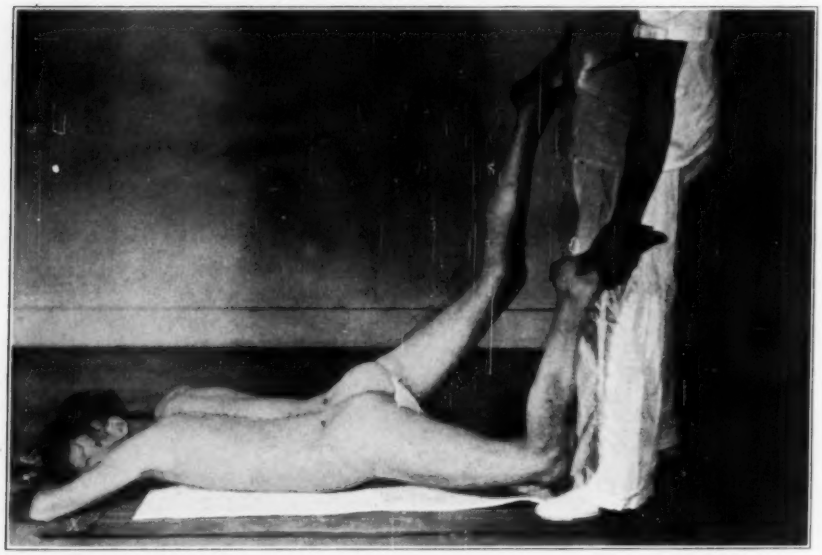

FIG. 10-B

Manoeuver 8—hyperextension of spine plus rotation of pelvis, first to left and then to right, with spine in hyperextension. (Lumbosacral manoeuver, resulting in hyperextension plus rotation of joint.) The legs are likewise moved from left to right, so as to describe an arc in relation to the trunk. Has tendency to efface list by mobilizing lower thoracic and lumbar spine in lateral direction.

here reversed, and the iliolumbar ligament and the sacrospinalis on this side are stretched.

Résumé: Manoeuvers 3 and 4 primarily mobilize the right sacro-iliac joint with secondary mobilization of the lower thoracic, lumbar, and lumbosacral interlaminar articulations in a direction the reverse of that obtained in Manoeuvers 1 and 2.

Manoeuver 5

The patient assumes the prone position. The manipulator then places his right hand forcefully over the left gluteus maximus, being *careful not to bridge the sacro-iliac joint* (Fig. 7-A). He then hyperextends the patient's left thigh with his left hand (care being taken that the knee is fully extended).

Discussion: This usually produces severe pain on the involved side, especially if there is a contracted tensor fasciae latae present. At times the response is more painful if the manipulator's right hand presses down on the sacrum only (Fig. 7-B), while the leg is being hyperextended. This is apparently the result of increased leverage on the sacro-iliac joint.

Manoeuver 6

Similar manoeuvers are carried out on the opposite thigh.

Résumé: These Manoeuvers 5 and 6 are primarily effective in the direct stretching of a contracted tensor fasciae latae, as well as in the rotary mobilization of the sacro-iliac joint. Secondarily, they serve to stretch contracted flexor muscles of the hip.

Manoeuver 7

This manoeuver is one in which the weight of the patient's trunk is used opposite the weight of the patient's legs to bring about flexion of the lower lumbar spine and finally of the hips. With the patient lying prone, the manipulator stands directly over the patient's pelvis (to protect his own back from strain), grasps the anterior superior spines, and with the patient as fully relaxed as possible raises the patient from the floor, causing him literally to "fold up". (See Figure 8-A.) While maintaining this position, the operator rotates the patient's pelvis first to the left and then to the right. (See Figure 8-B.) If the patient's weight is too great for the manipulator, this same procedure is carried out using a belt, so that two manipulators carry out the same movements of flexion and rotation as described. (See Figures 9-A and 9-B.)

Discussion: This manoeuver primarily mobilizes the lumbosacral joint and the interlaminar articulations, first by flexion and then by opposing rotary movements. It is especially painful in lumbosacral involvements, although pain is occasionally complained of in cases of sacro-iliac involvement. Secondarily, the manoeuver stretches the contracted sacrospinalis muscles.

FIG. 11

Manoeuver 9—passive straight-leg raising. (Modification of Baer's technique,—counter-clockwise rotary movement of sacro-iliac joint.)

Manoeuver 8

The patient is in the prone position. The manipulator takes hold of the patient's feet and raises up the lower extremities wheelbarrow fashion, hyperextending the lower thoracic, lumbar, and lumbosacral interlaminar joints (Fig. 10-A). Next, hyperextension being maintained, first one and then the other thigh is dropped, so as to rotate the pelvis also (Fig. 10-B). The legs are also carried from left to right, so as to describe an arc in relation to the trunk. This has a tendency to efface the list by mobilizing the lower thoracic and lumbar spine in the lateral directions.

Discussion: Hyperextension of the lumbosacral joints is primarily intended, although the manoeuver rotates the ilium forward on the sacrum and tends to give clockwise rotation to the sacro-iliac joints.

Manoeuver 9

Passive straight-leg raising, according to the Baer technique of flexing the hip joint with the knee fully extended, is carried out on both sides. The pumping movement is used to increase the range of flexion when pain is encountered and better relaxation is desired. (See Figure 11.)

Discussion: It is noteworthy that, when this manoeuver is carried out without anaesthesia, and when passive straight-leg raising is carried out on the affected side, the pelvis on this side occasionally rises upward from the floor and rotates to the opposite side. This results from the patient's attempt to substitute abduction for forced flexion, in order to escape further pain. Hence, the assistant operator holds down the iliac crest on the affected side.

Résumé: This manoeuver, of course, is primarily intended for sacro-iliac mobilization.

FOLLOWING MANIPULATION

The patient resumes the prone position. He is now shown how to progress from the prone position to that of standing with the least effort and likelihood of further strain. It is definitely believed that many backaches are prolonged because of trauma produced by improperly executed movements. Accordingly, the patient is asked now to change from the prone to the standing position by first coming to the knee-hand position, keeping the spine arched in flexion as much as possible. When the hands approach the knees, the patient is asked to put the good foot forward (the foot opposite the site of pain), placing it squarely on the floor, to lay both hands on the flexed knee, and to push downward, thus using the arms and the shoulders to extend the spine on itself and on the hips, instead of employing the back muscles normally coming into play in such a movement. Patients invariably welcome the relative ease with which they are now enabled to change position.

POST-MANIPULATIVE ROUTINE

Following manipulation, the comparative ease with which the patient moves about attests the relief of muscle spasm and the acute radiating pain. This outcome would prove quite short lived in many instances if the patient failed to observe more or less complete rest for a given interval. For this reason, when patients are manipulated in the hospital, the bed is immediately made ready for them. There are boards under the mattress. The mattress is never an inner-spring type, but one made either of felt, hair, or kapok. The author feels that the inner-spring mattress is the most debilitating of modern contrivances, and constitutes a curse of the present era. Pillows are assembled in the middle of the bed, and the patient is shown how to get into the bed properly.

He steps up on the stool with the right foot (given an involvement of the left side), followed by the left foot. Both hands and the right knee are placed on the bed. Bearing all weight on the right knee, he then brings up the left knee and assumes the knee-hand position on the bed. Moving over to the middle of the bed, he lies prone over the pillows, thus flexing the low back. Infra-red heat at a distance of thirty inches is applied for thirty minutes. This latter routine is repeated every four hours. Twice a day, the patient practises alternate straight-leg raising, and he is manipulated as often as the condition warrants. Special attention is paid to nursing details, and no type of bed pan other than the special orthopaedic bed pan is ever allowed. The ordinary type of bed pan very often aggravates or precipitates an acute attack as quickly as would any other awkward movement and should be avoided. In getting out of bed, the patient assumes first the prone position, then the knee-hand position; he then moves the knees over to the edge of the bed, and, bearing

weight on the left knee, he lets himself down on the right foot, followed by the left.

The usual duration of hospitalization for the chronic case is ten to fourteen days; that for the acute case, from two to three days. On discharge, the patient is generally equipped with some type of support such as an Osgood belt or a high-back corset. He continues the routine of heat and exercises at home as he did in the hospital. A rather important phase of post-manipulative treatment is the education of the patient to the business of saving himself from further trauma and sprain in performing his daily activities. Besides the proper methods of getting in and out of bed, he is taught how to arise properly from a sitting position and *vice versa* (most important in lumbosacral involvements); how to lean over properly and to arise from a stooping position; and how to drive his car with the least fatigue. Patients seen in the office and the home are made to follow the same routine of complete rest, heat, and exercises that is prescribed in the hospital. With the satisfactory alleviation of pain, relaxation of muscle spasm, and correction of the list, the patient is again allowed to introduce himself into his usual normal employment.

CASE REPORTS

The present manipulative routine is the combination of various individual manoeuvers adopted over a period of seven years in the treatment of some 327 patients complaining of backache. The following cases were selected as being typical of the kinds of low-back pain which respond favorably to this type of therapy. The multiple details of physical examination and of case investigation on a differential diagnostic basis have been purposely omitted for the sake of brevity.

CASE 1. *Lesion:* Acute low-back pain at the lumbosacral level, without radiation or list.

Etiology: S. W., male, aged thirty-six years, a gynecologist, attempted to unhook bumpers on the rear of a car one hour previous to examination.

Treatment: Manipulation with considerable immediate relief.

Course: The patient was seen in the office. He returned to his home, where the post-manipulative routine was followed. Two days later he was completely free from symptoms and has remained so to date.

CASE 2. *Lesion:* Low-back pain, localizing about the right posterior superior spine and the posterior sacro-iliac ligament, with a mild list to the left and radiation of pain down the posterior thigh (right) and, more recently, over the anterior aspect of the thigh and into the scrotum.

Etiology: C. B. J., male, thirty-eight years of age, an otolaryngologist, three weeks previous to examination, was seized with pain when attempting to lift a boat during a fishing trip; this had been aggravated by attempts at exercise and the long drive home.

Treatment: Manipulation with some immediate relief, but little change in the clinical picture.

Course: The patient was seen in the office. He returned home and observed the post-manipulative routine. Manipulation was again carried out on the following day. On the third day, examination disclosed subsidence of both signs and symptoms. Manipulation was deferred. Normal routine was adopted on the following day without any prescribed support. There were no subsequent attacks.

CASE 3. *Lesion:* Localized tenderness over the left iliolumbar ligament, the left gluteal region lateral to the posterior superior spines, and most marked over the left posterior sacro-iliac ligament.

Etiology: L. D. L., male, fifty-three years of age, a manufacturer, slipped on the ice. His effort to prevent falling precipitated an acutely painful back. At the time, he was under an internist's care for a chronic cardiac disability as well as an asthmatic condition. There was also present an old large right inguinal hernia.

Treatment and Course: The patient was seen in the home. Following manipulation the patient, who previously had been unable to move freely, was able to get up from the floor and walk to his bed. On the following day, he was writing at his desk and apparently quite comfortable. There was some slight residual soreness. Several hours later, in stooping to tie his shoes, another attack of pain was precipitated which was again relieved by manipulation. Two days later, the patient left on a trip. No further episodes have interrupted his regular routine.

This latter case is presented primarily to emphasize the point that manipulation is not a drastic or dangerous procedure if properly carried out.

CASE 4. *Lesion:* Anterior displacement of the sacrum on the fifth lumbar vertebra, manifesting itself as intractable low-back pain without list or radiation, with severe exacerbations and symptom-free remissions, unaltered by previous diligent treatment and several intervals of hospitalization.

Etiology: G. V. R., male, aged forty-six years, a manufacturer, experienced the initial attack in 1930. Following admission to Barnes Hospital in June 1937, roentgenograms in the supine and standing positions disclosed the lesion already described.

Treatment and Course: Following several manipulations, the patient was comfortable enough to return to his daily routine wearing an Osgood belt. Residual pain gradually disappeared. The patient was checked at several monthly intervals, at which times he declared himself to be asymptomatic. In January 1938, he was readmitted by ambulance with a severe acute attack. He was manipulated once following admission, placed on post-manipulative routine, and discharged on the third day, again asymptomatic. From the beginning, he has been warned about recurring attacks and acquainted with the possible future necessity of a spinal fusion.

CASE 5. *Lesion:* Severe sciatica (acute exacerbation) of the left lower extremity of a year's duration, causing complete incapacitation.

Etiology: Indeterminate.

Treatment and Course: E. G., aged thirty-six years, a mail clerk, had been having intermittent attacks for a year. He was admitted to the Jewish Hospital where, during the course of a week, he was manipulated daily for three days and every other day thereafter. During this interval the list lessened considerably; there was quite definite surcease from pain; and all his movements were performed more normally. He has been busy in his daily routine for the past ten months without a recurrence.

CASE 6. *Lesion:* Intractable sciatica of the right lower extremity of two years' duration, originating in the region of the right sacro-iliac joint. Hypo-active right patellar reflex with moderate atrophy of the right calf group and slight obtundity to heat, cold, and touch in the right leg and foot. Lumbar puncture was negative.

Etiology: Indeterminate.

Treatment and Course: I. S., male, aged fifty years, a tailor, was admitted in a wheelchair to the Jewish Hospital on October 23, 1934. An absolute-alcohol injection was performed on November 7, 1934. Examination revealed loss of pain and of sensibility to touch in the region of the second, third, fourth, and fifth sacral vertebrae on the right, with urinary incontinence. The patient was readmitted on January 14, 1935, with the complaint of low-back pain and urinary incontinence. Before another alcohol injection

was done, orthopaedic consultation was requested. Manipulations were advised. Following a series of these, the patient obtained relief from the pain, and his active movements were vastly improved. He was discharged on February 4, 1935, to follow a post-manipulative routine at home. On February 18, 1935, he was readmitted for a mild exacerbation, apparently precipitated by overzealousness of the patient in exercising. He was manipulated again, with prompt improvement, and was discharged.

DISCUSSION

In this paper the author has attempted to present in some detail a manipulative technique that found its inception some seven years ago and arose from the need for effective and immediate treatment of low-back sprain. At that time, it was used entirely for acute conditions. Since that time, the results have proved phenomenal in so many cases that the treatment has been attempted in cases of chronic back strain, with as gratifying results. During the ensuing years, the technique has been employed in several hundred cases, and the results have been rather closely studied. In some types of cases, the patients reacted in a wholly favorable manner when only one side was manipulated. In other cases, they did not completely respond until the entire manipulative technique had been carried out. In acute cases, further attacks were prevented by the early initial manipulation; in chronic cases, many patients responded well enough after several manipulations to be considered cured, while many more were given marked relief and were saved from further attacks by post-manipulative instructions in performing carefully their daily routine duties.

This manipulative technique is not offered as a cure for all cases of low-back pain. Rather, it is presented as another adjunct to the physician's armamentarium in the treatment of *one group* of low-back conditions. It is not always sufficient in itself, but must be followed up by other orthopaedic measures. Postural defects not the immediate result of acute muscle spasm—such as pronated feet, internally rotated femora, relaxation of the lower abdominal wall, lordosis with an anteriorly tilted pelvis, contracted sacrospinalis muscles, flat chest and round back, etc.—are noted and corrected. By the systematic strengthening of the abdominal muscles and the stretching of the shortened sacrospinalis muscles, the pelvic tilt is corrected and the abnormal lordosis is obliterated. An occasional patient presents a marked anterior tilt of the pelvis and, as demonstrated by the Ober abduction and Ely tests, a definitely contracted fascia lata. Routine corrective exercises are definitely impeded by the shortened fascia, and, in these instances, section of the fascia according to the Ober technique hastens the correction of the abnormal pelvic tilt, allowing for more effective shortening and strengthening of the abdominal muscles. Following failure of the conservative regime, the various operations for the correction of known anatomical defects must be considered. This alternative fortunately has not been a frequent one in the author's experience. The likelihood of a favorable prognosis in the conservative treatment is much enhanced, of course, the earlier the condition is seen

and treated. As a rule, it is much easier to correct the condition completely by treating the initial attack than by treating the latest of a series of attacks over a period of years.

In conclusion, the reason, apparently, that manipulative surgery without anaesthesia has been looked upon with disfavor by the medical profession is the general lack of understanding of its position and of its careful application to the proper case.

SUMMARY

1. A manipulative technique performed without anaesthesia is advanced as a treatment for low-back sprain, whether it be acute or chronic.

2. The technique found its inception in the need for a means of affording immediate relief to those individuals who, in the course of some activity requiring muscle exertion, have been abruptly seized with acute back pain and rendered helpless. Later, it was found that these manipulations were equally effective in the more chronic back conditions.

3. It has been used during the past seven years in several hundred cases, yielding varying degrees of immediate relief in every instance, and gratifying recovery in the greater percentage of cases.

4. The treatment is selective in type, and its employment is restricted to those cases of low-back pain which, either directly or indirectly, are of sprain etiology, and include the following groups: anatomical variations (sacralization, impinging transverse processes, etc.), congenital anomalies, poor posture (contracted tensor fasciae latae, marked lordosis, etc.), dislocations (apophyseal subluxation, spondylolisthesis, etc.), fasciitis and myofascial syndromes, and sprains (acute or chronic) of traumatic etiology.

5. Its successful employment without anaesthetization of the patient enhances its value in emergency use.

6. Contra-indications depend upon the accuracy of the diagnosis. One presupposes satisfactory relaxation of the patient and a manipulative technique that is neither rough nor unduly forceful.

7. The post-manipulative routine emphasizes the importance of immediate and adequate bed rest; intervals of infra-red therapy and regulated exercises; the *proper* performance by the patient of routine every-day actions (such as getting up from a chair or sitting down, getting in and out of bed, leaning over to pick up an object, and driving his car) which, improperly done, tend to precipitate an acute exacerbation; and finally, in chronic cases, the temporary use of adequate support.

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ADAMANTINOMA OF THE TIBIA

A Report of Two Cases

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Until the year 1913, a case of primary epitheliomatous tumor of the bone of an extremity had never been recorded in the literature. Many primary tumors of bone of endothelial origin had been described, but Fischer reported the first epithelial bone tumor, a primary adamantinoma of the tibia. This tumor is apparently identical with that recognized in the jaw under the names "adamantinoma", "adamantoblastoma", and "epithelial odontoma", arising from the enamel-forming elements of the developing tooth of a four-months' foetus. Extramaxillary adamantinomata have been reported in the neighborhood of the pituitary gland.

The report of Fischer's first case was concerned largely with the difficulty of the microscopic diagnosis, very little space being devoted to the clinical side. In this case, the involved portion of bone was resected and an osteoperiosteal graft from the sound leg was inserted. Eight months after the operation, the patient was in good health.

In 1930, Richter reported the second case. Under the diagnosis of myelogenous sarcoma (roentgenographic diagnosis), the leg was amputated above the knee. The chief difference in these two cases was in the age of the patient,—Fischer's patient was a man thirty-nine years old, and Richter's patient was a boy twelve years old. They resembled each other in that a definite trauma was reported in both cases, the tumor was in the same position in the tibia, operation was performed under the diagnosis of sarcoma, and the pathological picture was identical.

The third case was reported by Baker and Hawksley in 1931. The patient was a man forty-six years of age, also with a definite history of injury to the tibia. The roentgenographic diagnosis was myeloma. The operation consisted in a subperiosteal resection of about four inches of bone at the tumor site. Convalescence was uneventful, and there had been no recurrence two months after operation. The subsequent history in this case is not recorded.

In Ryrie's case, reported in 1932, an outstanding fact was the long latent period,—the trauma in 1913 and the appearance of a swelling in 1923. This tumor was diagnosed as a sarcoma, and amputation was advised and refused. In 1931, eighteen years after the injury, the tumor area was "scraped out". The material was examined by a pathologist and reported as adamantinoma. Six months later, the tumor recurred and grew rapidly, and amputation was performed. In this case, even in the recurrence, the tumor was confined strictly to the bone.

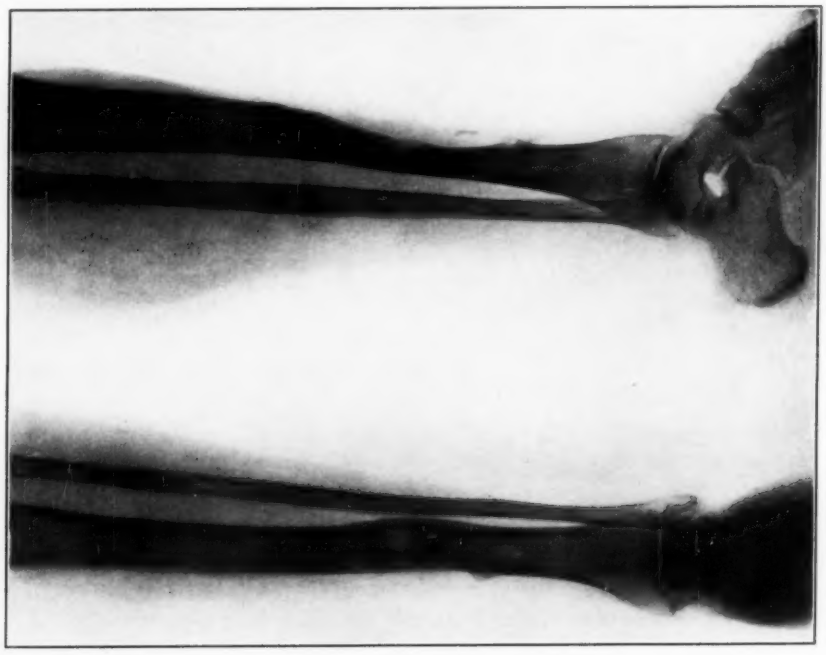

FIG. 2

Case 1. Showing the resected portion of bone with local recurrence.

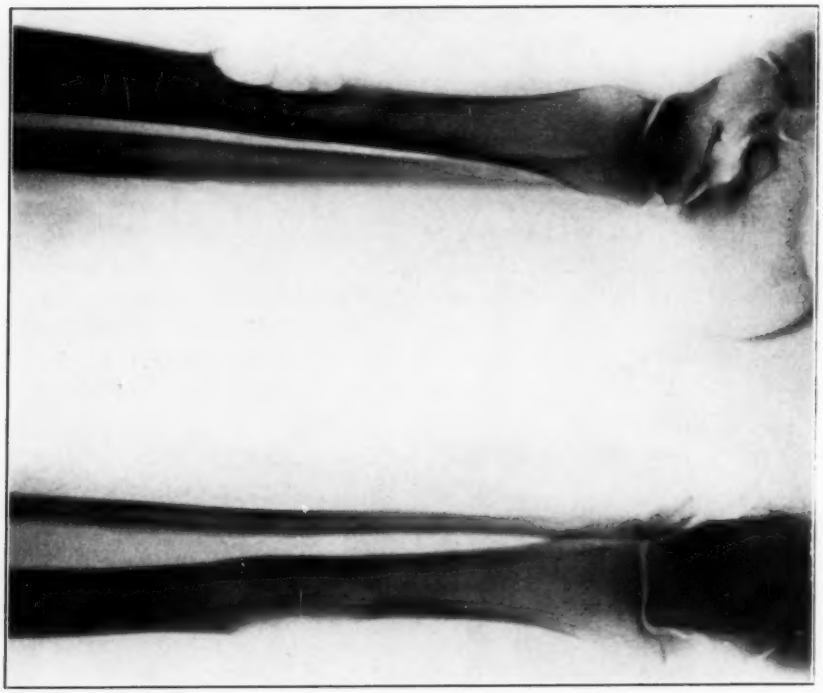

FIG. 1

Case 1. Tumor before operation.

The fifth case to be recorded, and the first in the American literature, was reported by Holden and Gray in 1934. In this case, as in the other cases, there was no evidence of tumor formation in any other part of the body. Also, as in the previous cases, there was a definite relationship between trauma and the lesion, and there was no invasion of the soft tissues. A preoperative diagnosis of bone cyst was made. The pathological diagnosis of malignant adenoma was made and was concurred in by three pathologists. The facts that no primary growth could be discovered in the body and that further histological study showed no structures from which the primary origin of such a neoplasm could be determined were puzzling. This patient was operated on in April 1931. The tumor, surrounded by healthy bony tissue, was removed by a mallet and a large gouge. In June of the following year a second operation was performed because of a recurrence,—the tumor was resected as in the previous operation, and the cavity was treated chemically. Following the second operation, a diagnosis of adamantinoma was made and roentgen-ray therapy was instituted. This patient has since come to amputation.

Another case recently reported by Bishop, the second in the American literature and the sixth case recorded, showed the characteristics of the previous cases. This patient, following local recurrence of the tumor, also came to amputation.

The most recent case has been reported by Rehbock and Barber. Here, the preoperative diagnosis had been a Brodie's abscess. Since only eight months have elapsed, it is too early to draw conclusions as to the ultimate outcome.

After reviewing all the cases to date, one must conclude that the diagnosis can be arrived at only from the histological examination. It would also appear that adamantinoma is malignant in that it frequently recurs, and it is not malignant in the sense that it does not metastasize.

Our cases, the fourth and fifth in the American literature, follow:

CASE REPORTS

CASE 1.* I. T., a female, fifty-seven years of age, was admitted to the Hospital for Joint Diseases on March 26, 1934, with the complaint of pain in the left leg of four months' duration, following a bruise caused by striking the leg against a chair fifteen months previously. This had been followed by a swelling which at first was painless. This swelling had increased and had become tender. With motion of the ankle there was pain at the site of the swelling. There had been no treatment prior to admission.

The family history and the past history were irrelevant.

Local examination revealed a swelling of the left leg, about two and one-half inches in diameter, on the anterior surface of the tibia at the junction of the middle and lower thirds. This was sensitive to touch and non-fluctuant. There was slight elevation of skin temperature with a nodular induration of the skin.

Roentgenographic examination (Fig. 1) revealed "a fibrosis cystica of the tibia but the fibula was suggestive of early Paget's disease as shown by thickening of the cortex and periosteum; definite thickening of the cortex of the tibia above the site of pathology".

Dental examination disclosed an impacted lower third molar, but there were no signs of a cystic condition. The upper and lower dentures were false.

* From the Service of Leo Mayer, M.D.

Pelvic examination showed an enlarged uterus, which was movable and underflexed. Curettage was advised. The tissue removed proved to be negative.

On March 28, 1934, an exploratory operation was performed. A five-inch incision was made over the tumor mass. The tumor involved the periosteum and the cortex, but not the marrow cavity. The tumor, with the surrounding healthy bone, was removed *en masse* by means of a large gouge and mallet. The wound was closed without drainage, and a plaster-of-Paris cast was applied to the leg and foot.

FIG. 3

Case 1. Resection of the tibia with graft *in situ*.

Postoperative roentgenograms revealed complete removal of the bone tumor. The pathological report was: "Adamantinoma of the tibia".

The wound failed to heal in certain areas, but the patient was discharged on April 18, 1934, to the Out-Patient Department. The wound continued to discharge a yellowish fluid, and marked excoriation of the adjacent skin or dermatitis was present. Despite repeated and varied applications, the ulcerated area failed to heal. During this interval, the patient experienced almost constant pain in the left leg, which was exaggerated by weight-bearing.

A roentgenogram (Fig. 2), taken on July 29, 1935, showed a recurrence of the cystic bone tumor. On August 12, 1935, after consultation with Dr. Milton Friedman, another resection of the tumor tissue was decided upon as irradiation was considered to be contra-indicated because of the unhealthy skin condition.

On August 28, 1935, a complete resection of the involved portion of the tibia, including the periosteum from five to fifteen centimeters above the internal malleolus, was performed. To fill in the resultant gap, a massive bone graft, pointed at either end, with periosteum from the opposite tibia, was inserted. (See Figure 3.) Later a portion of this graft sequestrated and had to be removed. The wound eventually healed after a most persistent and baffling dermatitis.

For the pathological diagnosis of the original tumor we are indebted to Dr. Henry L. Jaffe. The report on the resected portion of the tibia and periosteum follows:

"*Gross:* The specimen consists of a length of tibia measuring ten centimeters. On stripping the periosteum, which was only moderately adherent, the site of the previous operative intervention was disclosed by a hollow on the surface of the tibia. The surface of the bone presents two distinct elevations of rather firm soft tissue. On longitudinal section of the tibia, further details concerning these and other similar but completely intra-osseous nodules became apparent. They are rather firm, round to oval, low, and white in color. The smallest measures approximately six millimeters in diameter; the largest, almost twenty millimeters. They are eroding and destroying the cortex. They are very sharply demarcated both in the cortex and in the medulla.

"*Microscopic:* Section through the largest nodule shows a tissue whose histological architecture corresponds well with that ordinarily considered as typical for adamantinoma. [See Figure 5.] The striking feature of the lesion is that it provokes practically no periosteal reaction. It does not infiltrate the bone adjacent to the region of its growth. It induces no particularly rarefying or sclerosing changes in the neighboring bone. Some sections through the periosteal tissue contain nests of tumor in the region of the scar of the previous operation. One of the periosteal sections shows a small tumor nodule where this tissue was directly in contact with the bone.

"*Diagnosis:* Adamantinoma of the tibia (recurrent)."

The patient was subsequently readmitted for lengthening of the Achilles tendon for an equinus deformity. The wound healed *per primam* and the patient was discharged to the Out-Patient Department, wearing a leg brace to control the tendency toward bowing of the leg. After several months the patient was readmitted for an ulceration on the leg and a persistent dermatitis. This condition in time cleared up and the patient was able to walk. In February 1938, almost four years after the first operation, there was no sign of a recurrence. (See Figure 4.)

CASE 2.* E. R., a white female, eighteen years of age, on January 3, 1936, fell on an icy pavement. Following this there was a painful sensation in the right leg. She was given first-aid treatment at a city institution and was later removed to the Hospital for Joint Diseases with the leg in a plaster-of-Paris bandage.

The family history was negative and irrelevant.

The patient stated that four years previous to admission, while high jumping, she had struck her right leg on a wooden bar. The small abrasion produced at the time had healed quickly, but the leg had remained tender to pressure ever since. This tenderness had increased and for the past four months she had walked with a limp due to pain in the right leg on bearing weight. There was no pain at rest.

Physical examination, except for the local condition in the right leg, was negative.

Roentgenographic examination (Fig. 6) by Dr. Maurice Pomeranz revealed the following: "In the distal half of the shaft of the right tibia, with the exception of the distal metaphyseal area, a medullary, trabeculated, slightly expansile lesion is noted, through the proximal end of which an oblique pathological fracture, with slight displacement of the fragments, is seen. Irregular bone-productive changes are present throughout. The cortex, on the upper and anterior aspect at the site of the lesion, is irregularly eroded and a semilunar, circumscribed soft-tissue shadow is seen projecting through the muscle bundles. There is a negligible periosteal reaction. A few small,

FIG. 4

Case 1. Showing regeneration of bone from above and below at site of resection, two and one-half years later.

* From the Service of Samuel Jahss, M.D.

FIG. 5

Case 1. Photomicrograph of the histological specimen.

ovoid, rarefied, medullary lesions are seen at the junction of the upper and middle thirds of the shaft of the tibia. There is also a complete oblique fracture through the proximal end of the fibula with no displacement of the fragments. The chest plate shows no metastases."

The blood count was normal, and various other tests did not yield any additional information as to the nature of the pathological lesion.

A biopsy was performed on January 13, 1936, nine days after admission. A six-inch incision was made over the lower half of the right leg, exposing the site of the fracture and the tumor. There was a blood clot between the fragment ends. The cortex below the fracture was firm and trabeculated. When the cortex was removed, the marrow, for about three inches, was filled with a corrugated, encapsulated, grayish substance. This was scooped out quite readily with a bone curette. What we believed to be the entire tumor mass was removed, leaving a deep hole in the tibia. No definite diagnosis could be made from the gross specimen at the time of operation, and the tumor tissue was given to the pathological department.

The report of Dr. Henry L. Jaffe follows:

"*Gross:* The specimen consists of a considerable quantity of dense, fibrous tissue curetted from the marrow cavity of the tibia. The endosteal growth of this tissue was associated with thinning and rarefaction of the overlying cortex.

"*Microscopic:* Sections show fields of variably shaped cells, most of them being of

the spindle-cell to oat-cell type. They are of moderate size with vesicular nuclei containing nucleoli, pale and poorly perceptible cytoplasm and, for the most part, no discernible cell walls. Their arrangement in most areas is irregular. Scattered everywhere, however, are fair numbers of alveolar-like clusters. There are many places in which the cells assume a palisade arrangement as though demarcating the edge and tips of papillae. There is a considerable quantity of intercellular substance distributed throughout the tumor. This stains poorly. There are intracellular droplets of unidentified clear matter. Stroma is scanty. Giant cells are not seen, nor any considerable number of mitotic figures.

"*Diagnosis:* Adamantinoma of the tibia (diffuse or anaplastic)."

An additional note by Dr. Jaffe reads as follows: "This lesion is primary in the tibia and recurrence is to be expected. Metastasis is not an immediate probability. Radiation therapy will probably not prevent recurrence. Amputation is suggested as a curative measure in view of the extent of the lesion."

In February 1936, after consultation with our radiologist, Dr. Milton Friedman, radium therapy was instituted. After the wound had been reopened and the marrow cavity had been exposed, seven radium tubes, containing ninety-six milligrams of radium, were inserted into this marrow cavity. Two days later, these tubes in their vaselin-gauze pack were removed. The wound healed, and the patient was discharged in March 1936, wearing a plaster-of-Paris leg cast. Following this, the patient was observed in the Out-Patient Department.

A roentgenogram, taken on March 30, 1936, revealed what seemed to be an extension of the process, and one taken in April 1936 showed the same appearance with bone regeneration. However, when the plaster was changed in October 1936, the wound had broken down, the leg was swollen, and there were two foul discharging sinuses.

On February 23, 1937, a resection of the lower two-thirds of the right tibia was performed. The involved bone was dense and sclerotic and was removed *en masse*. The wound was packed with vaselin gauze and left open.

After examining the resected portion of the tibia, Dr. Jaffe again reported the presence of tumor tissue, and the microscopic sections again showed the pathological picture.

FIG. 6

Case 2. Showing site of fracture and tumor before operation.

Following the second operation, a high temperature developed, and the wound sloughed. Maggots, as well as urea crystals, were used on several occasions. Later, a pyocyaneous infection developed, which yielded to boric-acid dressings. In June 1937, the patient was discharged to the Out-Patient Department; the wound was still discharging. By November 1937, the wound had almost closed.

On February 14, 1938, the patient finally consented to amputation, and the extremity was amputated above the knee.

The report of the microscopic examination of the amputated specimen was as follows: "Sections show very extensive degeneration of the muscle; in places the latter is necrotic. The vessels throughout the section show marked thickening of all the coats and there is narrowing of the lumina of the arteries due to intimal thickening. Sections of the material filling the tibial dehiscence show this tissue to be fat and connective tissue, containing considerable amounts of tumor. The tumor is composed of closely compacted cells, most of which are spindle-shaped. Between the cells there is little, if any, intercellular material and the cells, themselves, present an occasional mitotic figure. The tumor seems to be invading the tissue along pseudo pad-like extensions, and, in places, the periphery of the tumor-cell masses seems to be demarcated by taller cells suggestive of basement epithelial cells. The tumor at this time presents the histological characteristics of the original tumor and those seen in the subsequent biopsies.

"*Diagnosis:* Adamantinoma of the tibia."

NOTE: In conclusion, we wish to express our appreciation to Dr. Leo Mayer and Dr. Samuel Jahss for their interest and help in reporting these unusual cases.

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EWING'S TUMOR (ENDOTHELIAL MYELOMA)

An Unusual Case Report with Necropsy

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A necropsy report of a Ewing's sarcoma (endothelial myeloma) is of material value because necropsies of this tumor are exceedingly rare,—only thirteen such reports have been found in the literature. These thirteen cases were reported by Sycamore and Holmes; Melnick; De Santo; Connor; Porter, Lonergan, and Gunn; and Charache. Much doubt has been expressed, particularly by European pathologists, that there exists such a tumor as a definite entity. The following report is of further interest on account of the duration of approximately six years. This is a much longer duration than any case we have seen in this Clinic.

CASE REPORT

History

M. B. (Registry of Bone Sarcoma No. 1828, our file No. 35279), white, female, aged twenty, came to our Clinic on January 15, 1935, complaining of pain and swelling in the left arm. The family history was irrelevant. The patient had had measles and mumps in childhood. She had complained of "rheumatism" in the left arm in the fall of 1931. This had lasted only a few days and she had had no fever. In 1933, while on a visit in Ohio, she had had another attack of "rheumatism" in the left arm. This attack was likewise of short duration and without fever. Three weeks after this attack, in August 1933, she had received a slight fall from a fence, resulting in a fracture of the left arm. She thought that the fracture of the humerus was sustained when the elbow struck the ground. The arm had been placed in a splint for a number of weeks, following which she regained almost complete function, but continued to favor the arm. She was told that the roentgenogram had showed some trouble in the bone at the time of the fracture. This was confirmed by the roentgenogram secured from Dr. H. E. Ward and Dr. H. W. Dierksheide, for which we wish to express our thanks. In December 1933 she had experienced *severe pain* in the arm with fever and delirium. She was confined to bed for ten days. She had experienced several similar attacks in the interval until the last attack, which had begun on December 30, 1934, and was the most severe of all of them. She had worked in a five and ten cent store during the Christmas season and had used the arm about as usual since the last attack. She had noticed a "knot" at the site of fracture ever since the splint had been removed. The arm had been enlarged for eight months previous to examination, and the muscles on the inner aspect of the arm had become harder.

Physical Examination

The patient was well developed and well nourished; she weighed 105 pounds and her height was five feet and one inch. The temperature was 98; the pulse rate, 90; and the blood pressure, 124/70. Aside from the left humerus, the physical findings were negative. The left shoulder was lower than the right. The acromio-epitrochlear measurements were as follows: right, twelve and one-half inches; left, eleven and one-quarter inches. There was a visible tumor in the upper third of the humerus. Palpation revealed a much thickened left humerus in the upper and middle thirds. No motion was felt at the site of the old fracture, but deep palpation elicited pain at this level. Arm

FIG. 1

August 25, 1933: Pathological fracture of the upper third of the humerus with definite destructive changes in and adjacent to the fracture site with soft-tissue swelling.

motion was as follows: abduction, 45 degrees; external rotation, 20 degrees; anterior extension, 60 degrees; posterior extension, 10 degrees. The radial pulse was palpable. Sensation in the forearm and in the hand was normal.

Laboratory Findings

The urine and blood were normal. The blood Wassermann test was negative.

Roentgenographic Examination

Roentgenographic examination, on January 15, 1935, revealed a destructive lesion involving the upper third of the shaft of the left humerus, solid union of the old fracture with some angulation, and swelling and increased density of the soft tissues around this region. The lungs revealed no metastases.

Clinical Diagnosis

A clinical diagnosis of Ewing's tumor was made.

Biopsy

A biopsy was done on January 16, 1935. The specimen consisted of three small pieces of blood-stained and oedematous soft tissue. The cut surface was pinkish blue, glistening, moist, and slightly granular. Some parts of it were myxomatous in appearance, while other areas resembled fish flesh and appeared to be quite devoid of blood. No definite capsule was seen.

The microscopic description was as follows: "This is a rich, cellular tumor growth. The nuclei of the cells are oval to round, for the most part, hyperchromatic, and vesicular. Nucleoli are noted. In places the cytoplasm is very faintly visible and takes a pale pink stain. Few mitotic figures are seen. The cells appear in sheetlike arrangement. In places the cells are concentrated in dense masses. These are found to be about blood vessels and in muscle and connective tissues. There is much hemorrhage here and there throughout the section. Blood vessels are numerous. The growth is invading muscle tissue."

FIG. 2

January 15, 1935: Increased destruction of bone with faint onion-peel reaction at the lower portion of the tumor. The fragments of the pathological fracture are solidly united in satisfactory position.

FIG. 3

June 10, 1936: Just before resection of the humerus and following roentgen therapy. The bone has increased in density.

FIG. 4

August 26, 1936: Two and one-half months after operation. The upper three-fifths of the humerus has been resected and the fibula graft is held *in situ* by three rustless-steel wires.

FIG. 5

February 11, 1937. Nine months after operation. Note the recurrence of the soft-tissue tumor lateral to the graft.

Pathological Diagnosis

A pathological diagnosis of Ewing's tumor (endothelial myeloma) was made.

Treatment

As the patient declined amputation, deep x-ray therapy was begun on January 16, 1935,—200 kilovolts, all given with copper filter, at a distance of fifty centimeters, and for ten minutes. She received in all seven courses of deep x-ray therapy, amounting to 15,900 roentgen units. On January 25, 1935, Coley's toxins were begun. Seven courses were given, extending through April 1936. A course consisted of three doses a week for six weeks, given intramuscularly. A rest period of at least two weeks was allowed between each course.

Clinical Course

The response to deep irradiation was excellent. The tumor, the pain, the soreness, and the local fever subsided fairly rapidly. The reactions to Coley's toxin were severe, resulting in anorexia and loss of weight, but between courses the patient gained weight and improved in every way. In June she had a slight flare-up with pain, slight swelling, and increased local heat at the site of the tumor. The local symptoms and signs disappeared following x-ray therapy just as had happened previously. Frequent roentgenograms of the arm were taken, all of which showed a progressive condensation and solidification of the affected part of the humerus but no metastases to the lungs.

An intermittent soreness, at times with some pain and local heat over the site of the tumor, appeared again about Christmas 1935. Because of this, and in spite of the fact that the roentgenograms were negative for additional changes, surgery was again advised and agreed to, following which resection of the upper three-fifths of the humerus was done on June 16, 1936. A right-fibula graft was substituted for the resected humerus, the head of the fibula being placed in the glenoid fossa. Union occurred, and following physiotherapy, the patient obtained a fair degree of function. On account of agonizing pain in the right hip, she was admitted to the Hospital for Crippled Adults, and a roentgenographic examination was made on February 11, 1937. Destructive lesions in the left ilium, adjacent to the sacro-iliac joint, and in the neck of the right femur with a pathological fracture and a soft-tissue tumor at the site of the primary lesion were found. No metastases were seen in the lungs. The clinical course of the disease was downward from this time on with rapid loss of weight, and pain that required opiates, freely administered. A few weeks after admission to the Hospital for Crippled Adults, the left arm in the region of the original tumor began to

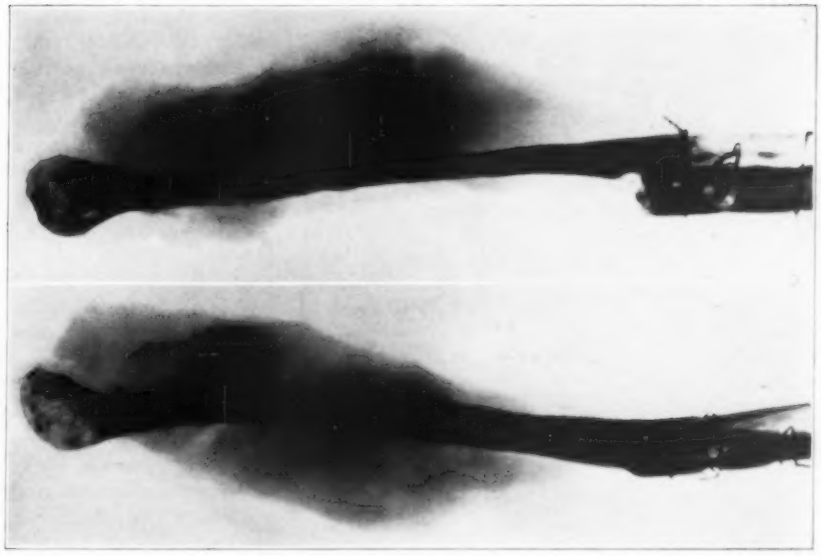

FIG. 6

Necropsy specimen, showing the extent of the soft-tissue tumor.

enlarge, and death occurred on April 28, 1937. Upon post-mortem examination this enlargement of the left arm was found to be due to a large tumor growth.

NECROPSY REPORT

External Examination

Examination showed a white female, aged twenty-two years, five feet and one inch in height, and weighing seventy-five pounds. The body was still warm, and the skin was white and dehydrated. There was marked emaciation with atrophy of the muscles. The eyes were sunken, and the lids were partly open. Sordes was present on the teeth.

There were two ulcers on the posterior and posteromedial aspect of the left elbow. A long healed scar on the anterior aspect of the left arm from the shoulder joint to the lower third of the arm and another scar over the lateral aspect of the upper third of the right leg were noted. The left elbow was flexed to a right angle. The right lower extremity was internally rotated. The entire posterior aspect of the torso had a bluish, mottled appearance. There was a firm nodular tumor growth over the upper two-thirds of the left arm in the region of the former operation. The lymph nodes were not enlarged.

Internal Examination

The head was not opened. When the body was opened, there was noted marked atrophy of the subcutaneous fat.

Pleurae: A small dark-red firm mass, two centimeters in diameter, attached to the left parietal pleura, to which the visceral pleura was adherent, was found about the costochondral junction of the first rib. Another similar mass, but twice as large, was found just above the diaphragm, which filled the angle between the aorta and the vertebral column. Neither of these had a bony connection. The right pleural cavity was normal.

Lungs: There was congestion at the bases of both lungs with small, irregular, firm hemorrhagic areas, ranging in size from a few millimeters to two centimeters, more marked in the lower left lobe. The tracheobronchial and hila lymph nodes were not enlarged.

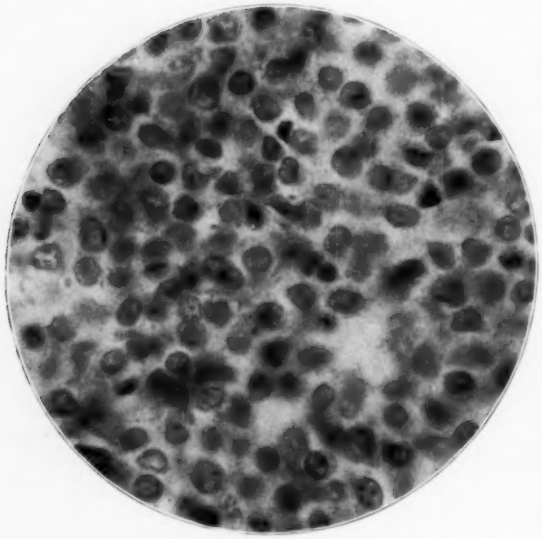

FIG. 7

Photomicrograph (oil immersion) showing small round cells with scanty, faintly stained cytoplasm. The nuclei are vesicular and eccentrically located. Note the occasional nucleolus and mitotic figure.

Heart: The heart was smaller than normal, and the muscle was very pale. The pericardial cavity contained a normal amount of fluid.

Kidneys: The right kidney was normal. In the left kidney there were two metastatic tumor masses, about one centimeter in diameter, well demarcated, slightly elevated above the surface,—one was hemorrhagic; the other resembled a fibroma, except that it was softer. The capsule was adherent at these points. The pelves of the kidneys were normal.

Spleen: The spleen was moderately firm; the capsule was smooth, the cut surface being moist, less red than normal, and without visible tumor nodules.

Stomach and intestines: These organs were not involved.

Suprarenal glands: The left suprarenal gland was riddled by hemorrhagic, moderately firm, oval nodules; the cut surface was dark red, smooth, and moist. Scarcely any gland tissue was visible. The right suprarenal gland was normal.

Liver: The liver was much smaller than normal and there were no metastases.

Gall bladder and appendix: These organs were normal.

Pancreas: Most of the body and of the tail was almost completely destroyed by tumor nodules which were semifluctuant, oval, and hemorrhagic in appearance. Upon the cut surface the centers were necrotic and surrounded by a homogeneous, smooth, dark-red, hemorrhagic tissue.

Mesenteric lymph nodes: The mesenteric lymph nodes were normal in appearance.

Ovaries: Practically all that remained was fibrouslike tissue, a by-product of irradiation.

Bladder: The bladder contained four ounces of urine.

Skeleton: A large tumor mass was found internal to the left sacro-iliac joint and the ilium. When this mass was

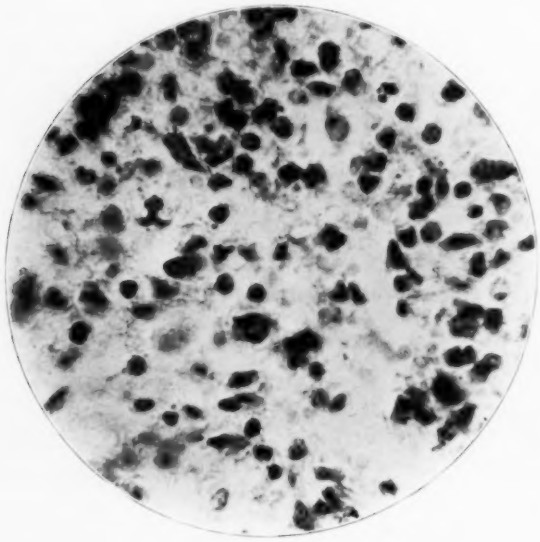

FIG. 8

Photomicrograph (oil immersion) of tumor cells in the medullary cavity distal to the pathological fracture.

removed, eroded bone was found beneath. The neck of the right femur was not explored. The left humerus, including the fibula graft, was removed. The graft was firmly united, but practically all of the fibula was surrounded by tumor. Three rustless-steel wires were noted *in situ* holding the humerofibula graft.

MICROSCOPIC EXAMINATION

Left pleura: Section of a nodule from the left pleura revealed a diffuse, rich, compact, cellular tumor which appeared to be on the surface of the parietal pleura. The cells composing the tumor contained fairly uniform, oval to round, deeply stained nuclei with nucleoli. Some of the nuclei were vesicular and contained a reticulum, while in most of them the chromatin was finely granular and evenly distributed. In the less compact portions of the tumor, the nuclei were larger. A palely stained granular cytoplasm, small in amount and irregular in outline, was visible about many of the nuclei. Mitotic figures were common. Just beneath the pleura and in the tumor, considerable hemorrhage was noted. Connective-tissue septa, extending down into the tumor from the pleura, were observed. Blood vessels were numerous.

Section of the growth along the side of the aorta revealed the same histological findings as already described, except that more hemorrhage and vascular stroma were noted. In one portion the hemorrhage seemed to be of considerable age with organization already begun.

Pancreas: The sections taken from different portions of the gland showed only remnants of pancreatic tissue. These small portions of the gland that had been infiltrated by the neoplasm showed marked evidence of cytolysis. There was a striking resemblance between the cells com-

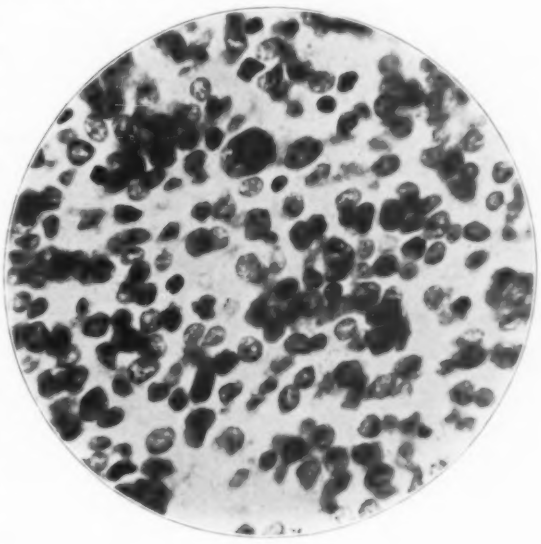

FIG. 9

Photomicrograph (oil immersion) of tumor of ilium, showing polyhedral cells. Note large, mononucleated cell.

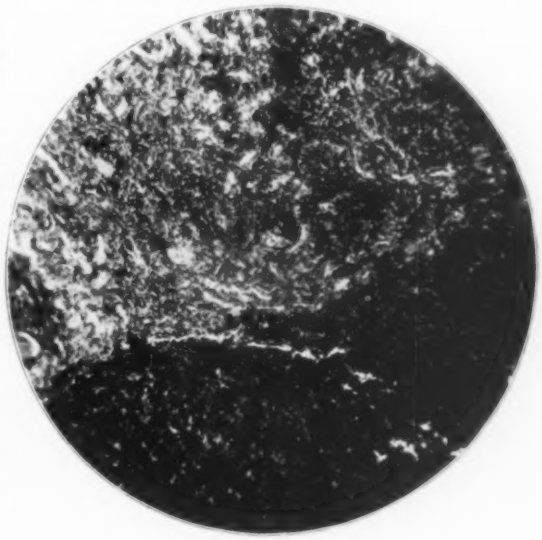

FIG. 10

Photomicrograph (low dry) showing the tumor infiltrating the kidney substance. The split in the section is on a plane with the capsule.

posing the islands of Langerhans and the tumor cells except for the pyknosis so marked in the island nuclei. Mononucleated and polynucleated giant cells and mitotic figures were quite common.

Left kidney: Sections of both tumor masses in the left kidney revealed the kidney tissue to have been destroyed by the infiltrating tumor, the histological picture being identical to that seen in the pancreas. The tumor appeared to have begun in or about the capsule of the kidney, resulting in a piling-up of cells outside of the capsule and an infiltration of the kidney parenchyma to a considerable depth. There was granular degeneration of the tubular epithelium, and some tubules were devoid of epithelium.

Suprarenal glands: Section of the two nodules in the left suprarenal gland revealed a dense, compact, cellular tumor of the same cell histology as those already described. There was a rich vascular stroma, and much hemorrhage was noted in places. No gland structure was discernable. Mitotic figures were quite numerous. The right suprarenal gland had a normal histology.

Iliosacral tumor: Section revealed dense, compact, cellular tumor growth, the nuclei of which varied in size, and many of them appeared as mononucleated and polynucleated giant cells. Mitotic figures were more numerous than in previously described sections. The tumor was infiltrating the adjacent muscle.

Heart: Section of the heart showed atrophic changes in the muscle.

Lungs: Small patches of cellular infiltration, particularly about some of the bronchioles and air vesicles, were noted. Much mucus was present in the lumen. No tumor cells were found.

Liver: Only degenerative changes, with some fatty infiltration, were noted.

Spleen: There was moderate congestion, and focal collections of phagocytes, containing blood pigment, were observed. Very few lymphocytes were seen, and these were in the perivascular tissues. Plasma cells were numerous.

Ovaries: The ovaries were little more than masses of fibrous tissue with numerous thick-walled blood vessels. There was no evidence of glandular function.

COMMENTS

The fact that the patient stated that she had rheumatic-like pain in the left arm in the fall of 1931 and again in July 1933, coupled with an unquestionable bone lesion at the time of the pathological fracture in August 1933 as revealed by the roentgenogram taken at that time, justifies the assumption that all symptoms complained of were probably the results of the Ewing's sarcoma. Intermittent attacks of pain in the upper third of the left arm and fever, therefore, were experienced for more than three years before we saw the patient. These intermittent attacks are common in patients with this tumor. She lived about five and a half years after the onset of the first symptoms and about twenty-eight months after admission to this Clinic.

Tumors that have been confused with Ewing's tumor with primary foci in the bronchi and in the adrenals have been reported. Careful examination of the bronchi was made in this case without finding any evidence of a tumor. Moreover, examination of the lungs proper was negative for neoplastic nodules. On the other hand, the left suprarenal gland was practically destroyed by the neoplasm as was also the pancreas. Colville and Willis have expressed their opinion that adrenal neuroblastoma will prove to be the primary growth in many cases reported as Ewing's tumor. One cannot state that the growth in the suprarenal gland was not primary

in this case, but the fact that there are patients alive six, eight, ten, and more years following radical surgical treatment with and without irradiation and Coley's toxin argues strongly against this theory. It is almost inconceivable to us that the tumor in the left suprarenal gland could have been the primary focus in this patient for such a long time and yet have remained so small. The size of this suprarenal tumor argues directly and positively against one of the cardinal principles of malignancy in that it did remain small. The microscopic sections showed marked cellular hyperplasia in the tumor and no tumor-cell necrosis. We are, therefore, of the opinion that the primary focus was in the left humerus.

The long duration of symptoms, which is so often the case before any definite diagnosis can be made, argues against Ewing's tumor as having its primary origin in some organ apart from the skeletal system.

Considerable criticism has been expressed regarding the incompleteness of previously reported necropsies, particularly with reference to the suprarenal glands and the bronchi. These organs were especially carefully investigated in this case as the foregoing report bears out.

More carefully made necropsy studies are urgently needed where this tumor is concerned, which perhaps will clarify some of the controversial points that now exist.

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SUPERIOR PULMONARY SULCUS TUMOR SIMULATING SUBACROMIAL BURSITIS

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Shoulder pain may be due to a local process or it may be referred from a lesion elsewhere in the body. It may be part of a symptom complex such as is frequently encountered in lesions of the upper spine, the cardiovascular system, and the pulmonary and mediastinal structures. Pain about the shoulder region requires an investigation of these structures before one can be sure that the cause is not outside the shoulder girdle. It is unusual to have sufficient local pathology to account for a patient's symptoms and then to find that the pain is due to a lesion elsewhere. The patient whose case is presented in this communication had both a calcified subacromial bursa and a superior pulmonary sulcus tumor. In the early stages of the patient's disease, it was believed that the subacromial bursa accounted for the pain, but, as the symptom complex progressed and other physical signs developed, the patient was found to have a neoplasm of the apex of the lung. It is because of the unusual combination of local and neighboring lesions, either of which could account for the patient's early symptoms, that the following case is presented.

FIG. 1

Roentgenogram of the upper half of the right chest and shoulder, taken May 26, 1936. There is a flat calcified plaque in the subacromial region. There is also a suspicious density in the supraclavicular region.

CASE REPORT

N. S., a white male, aged sixty-two years, was first seen on May 26, 1936. At that time he complained of pain in the right-shoulder region of four months' duration. There was no history of trauma or of infection either locally or systemically preceding the onset of the shoulder pain. The pain was more or less constant,

sharp, and radiating down the outer aspect of the right arm as far as the insertion of the deltoid and to the upper part of the lateral wall of the right side of the thorax. The pain was not relieved by infra-red radiation or by diathermy.

The patient was a well-developed, well-nourished male; there were no gross malformations nor deformities. The heart and lungs were essentially negative to percussion and to auscultation. Except for the findings in the region of the right shoulder, the physical examination was essentially negative. There was no atrophy of the tissues about the right shoulder girdle. There was some thickening of the tissues over the region of the greater tuberosity of the right humerus, with tenderness to deep palpation. No limitation of motion of the right shoulder nor weakness of the right upper extremity were noted.

Roentgenographic examination of the right-shoulder region on May 26, 1936, revealed a calcific deposit overlying the greater tuberosity of the right humerus (Fig. 1).

The patient was given a series of infra-red and diathermy treatments to the right-shoulder region, without relief of the pain. On July 14, 1936, under local novocain anaesthesia in the region of the calcific deposit, an attempt was made to aspirate the mass. It was punctured many times in fanwise fashion, but nothing could be aspirated. On withdrawing the needle, it was noted that the lumen was filled with an amorphous, calcified material. Following this, the patient was again given diathermy to the shoulder, supplemented by iron cacodylate intravenously. Slight relief was obtained for about a week, but gradually the pain returned and became so severe that the patient could not lie on the affected side. On September 22, 1936, a second aspiration was performed with the same result of aspiration but without relief of the pain. At the time of the aspiration, it was noted that the patient held the arm almost fixed against the side of the body and that abduction of the arm was limited. On October 14, 1936, the patient was operated upon for a subdeltoid bursitis. A one-inch incision was made in the deltoid muscle, the fibers were separated, and the subdeltoid bursa was exposed.

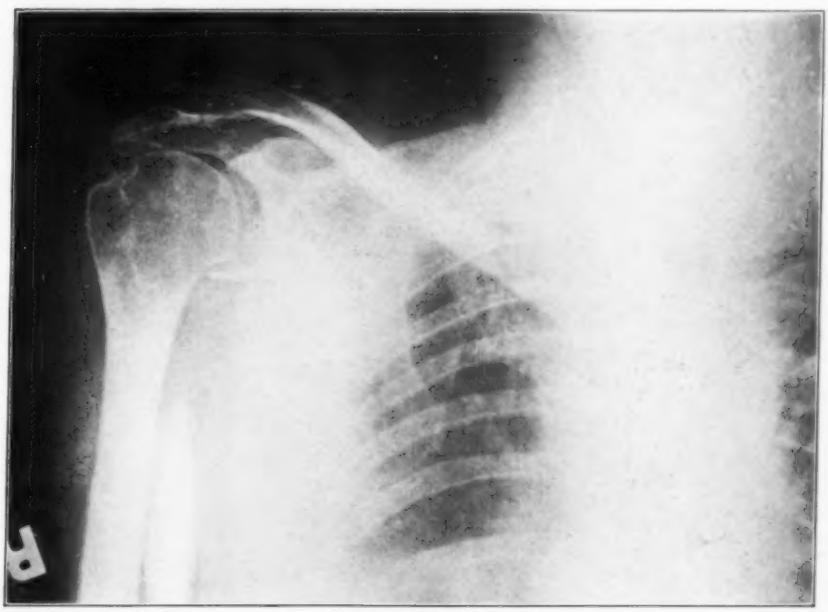

FIG. 2

Roentgenogram taken December 8, 1936, following the surgical removal of the bursa. There is still present a small amount of the calcific deposit. The pathology in the apical region is more clearly demonstrated.

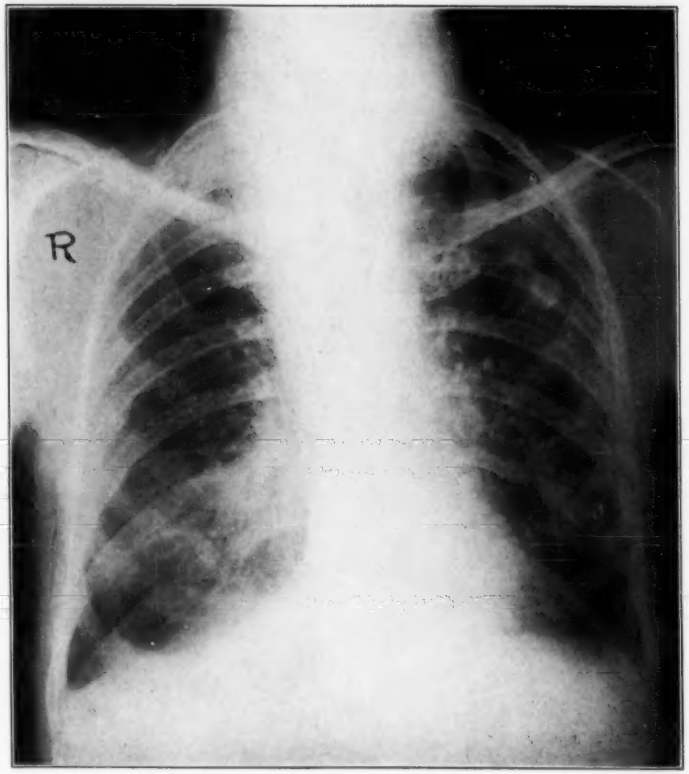

FIG. 3

Roentgenogram taken March 19, 1937. There is extension of the opacity (tumor) to the mediastinum.

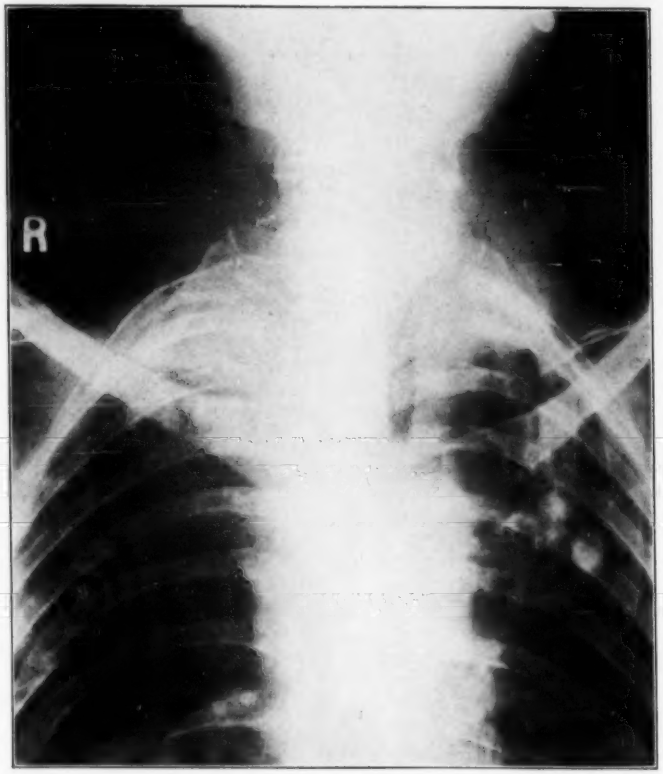

FIG. 4

Bucky study taken March 19, 1937. There is demonstrable, in addition to the findings shown in Fig. 3, a local erosion of the first rib and a periosteal reaction along the inferior border of the second rib. Also note that the trachea is displaced to the contralateral side.

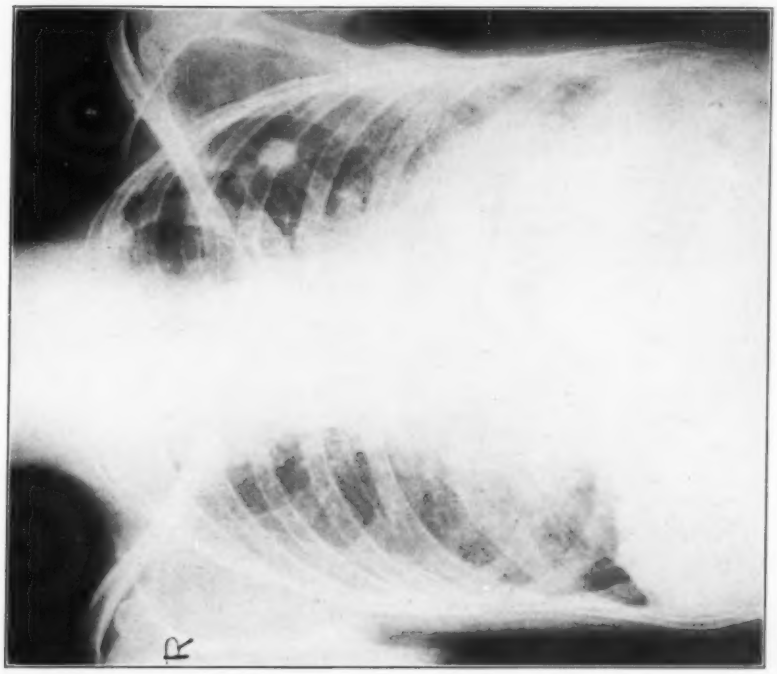

FIG. 6

Roentgenogram taken July 13, 1937. There is further progression of the apical and mediastinal pathology. In addition, there is evidence of a pericardial effusion.

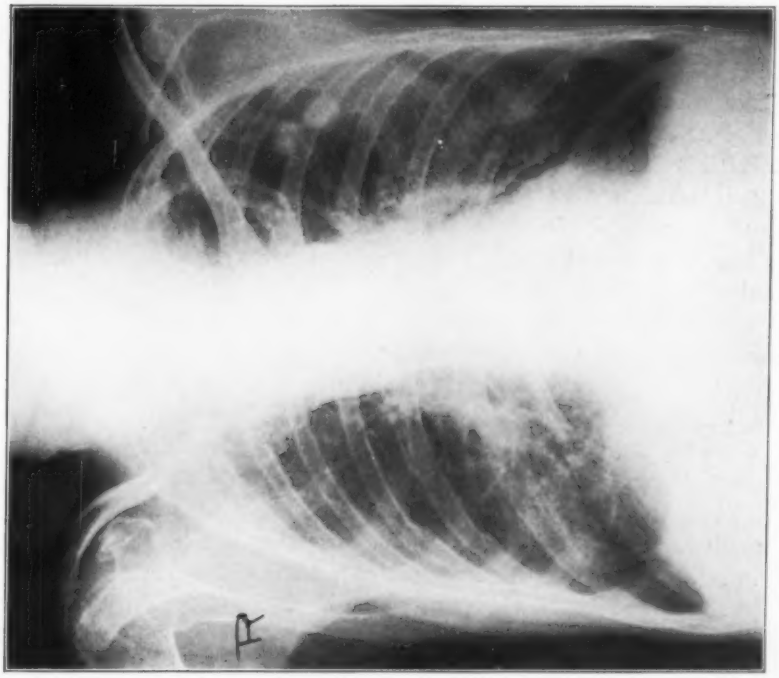

FIG. 5

Roentgenogram taken May 24, 1937. The tumefaction has increased in size. There is increased mediastinal involvement.

The bursa was opened and within the tendon of the supraspinatus a whitish area was found. The tendon was incised in the line of its fibers, and the whitish mass, composed of amorphous and calcified material, was curetted. Following the operation, the right shoulder was maintained in abduction and external rotation with some relief of the pain. The patient continued to improve for a while during his stay in a warmer climate. However, during the latter part of his sojourn the pain returned and was more severe than ever before. In addition, the pain now radiated down the inner aspect of the arm and forearm as far as the wrist. At this time, the patient began to lose weight and strength. On March 19, 1937, it was noted that the patient had a Horner's syndrome and atrophy of the muscles of the hypothenar eminence. Roentgenographic examination of the chest at this time revealed an area of opacity at the right apical region (Figs. 3 and 4), upon which basis, together with the physical findings, a diagnosis of superior pulmonary sulcus tumor was made. The patient's course from this time was progressively downhill. The tumor increased in size and extended to the mediastinum (Fig. 5). The pain became increasingly more severe and was barely relieved by large doses of opiates. Before death, the patient presented a picture of extreme cachexia with a superimposed pericardial effusion (Fig. 6). The patient became comatose and died on July 22, 1937.

The case described illustrates the necessity of examining the thorax in cases of persistent shoulder pain even though local pathology may be present. This is particularly true in those cases in which the patient's symptoms are not alleviated by the usual methods. It is our impression that calcification about the shoulder, particularly in elderly subjects, is not uncommonly found in routine roentgenographic examinations of that region. In many instances, these are asymptomatic. Familiarity with chest pathology is essential, since a lesion of the type reported herein may readily be overlooked by one not experienced in the interpretation of roentgenograms of the chest.

Pancoast, who first presented the subject of superior pulmonary sulcus tumor in 1924, in a further study in 1932 stated: "The name of 'superior pulmonary sulcus tumor' has been given to it because this term implies its approximate location and a lack of origin from the lung, pleura, ribs or mediastinum." In 1934, Jacox declared: "Opportunity to examine autopsy material from a case of this sort has convinced me that, at least in this instance, the tumor arose from the mucosa of the terminal bronchioles in the apex of the lung, and that the name 'primary carcinoma of the pulmonary apex' might be appropriate." Opinion varies as to the origin of these tumors. There have been too few cases reported to date to warrant any definite conclusions. Suffice it to say that they are malignant growths located in the apical pulmonary regions.

In the early manifestations of the disease the symptoms are more or less confined to the region of the apex of the lung and the shoulder. In the latter stages, the syndrome is characterized by symptoms due to pressure on the contiguous structures. By pressure on the brachial plexus and the ribs, the tumor causes pain, tenderness, and hyperaesthesia about the shoulder and the axillary regions, as well as at the other sites of distribution of the nerve fibers impinged upon. Atrophy of the muscles of the arm and hand is a late manifestation of brachial-plexus involvement. A Horner's syndrome frequently develops, due to sympathetic-

nerve involvement, and erosion of the first and second ribs manifests itself with the gradual expansion of the neoplasm in the region of the apex of the lung.

This syndrome is suggestive of superior pulmonary sulcus tumor. Such symptoms, together with a roentgenographically demonstrable apical tumefaction, are pathognomonic of the disease. Fried reported a case in which the first impression was that the patient had syringomyelia. Tobias described an apicocostovertebral-pain syndrome in apical tumors with the development of radicular pain and sympathetic-nerve involvement. Clinically, the syndrome may occasionally be altered by additional symptoms or by a variation in the severity of the local manifestations. In such instances, the primary cause is readily overlooked, as in the case herein presented.

CONCLUSIONS

In any case of persistent shoulder pain where active and thorough local treatment fails to alleviate symptoms, an investigation of surrounding structures should be made. Many roentgenological clinics routinely fluoroscope the chest in all cases of shoulder pain and, when suggestive pathology is found, roentgenographic studies are made of the chest. The finding of a calcified bursa in an elderly individual may at times mask the true cause of shoulder pain. A calcified bursa is not infrequently asymptomatic.

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PRIMARY ENDOTHELIOMYELOMA (EWING'S TUMOR) OF THE SACRUM

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Inasmuch as no similar case was found in a review of the literature, the authors wish to record a case of primary endotheliomyeloma (Ewing's tumor) of the sacrum, together with the findings at biopsy and at post-mortem examination. Ewing's tumor is most prevalent in the shafts of the long bones such as the humerus, the tibia, and the femur, but it also occurs in the ilium, the vertebrae, the skull, the ribs, the scapulae, and the bones of the feet. Primary tumors of the pelvic bones have been described most frequently in the ilium adjacent to the sacro-iliac joint.

CASE REPORT

J. G., a pale and poorly nourished girl of ten years, was apparently well until a few months previous to April 9, 1935, when she was first examined. There was no history of injury. She complained of pain at the base of the spine, lasting about two days and recurring at varying intervals. Her weight had been constant. On examination, there was slight tenderness to pressure in the upper sacral area. The spinal motions were normal. Roentgenographic examination on April 10, 1935, revealed only a spina bifida occulta of the first sacral segment (Figs. 1 and 2).

The patient was reexamined three months later. The intermittent pain in the lower back had persisted and she now complained of pain in the region of the right hip, radiating to the outer aspect of the calf. The child was admitted to the Jewish Hospital on July 22, 1935. The temperature on admission was 100.6 degrees and the pulse was 110.

FIG. 1 FIG. 2

Roentgenograms, taken on April 10, 1935, were negative except for a spina bifida occulta of the first sacral segment. There was a possibility of slight decalcification in the right sacral wing.

The gait was awkward and guarded, and the trunk listed slightly to the right. There was some tenderness to pressure in the regions of the posterior superior iliac spines. Flexion of the spine was possible to half the normal amount, but occurred with a list of the trunk to the right. Hyperextension of the spine was unrestricted, but caused discomfort referred to the right calf. Neurological examination was negative except for abortive nystagmus and exaggerated leg reflexes.

The patient left the Hospital on July 27, 1935, and visited the Orthopaedic Clinic ten days later. Her symptoms had persisted and she had lost three pounds in weight. Examination revealed tenderness on pressure to the right of the middle of the sacrum and the presence of a hard, slightly tender swelling of the tissues in this region. Roentgenograms (Figs. 3 and 4), taken on August 6, 1935, showed an area of absorption in the right side of the body of the sacrum medial to the sacro-iliac joint. There was some rarefaction of the lower portion of the right side of the sacrum and a bulging and thinning of the cortex in this region. The sacro-iliac joint and the ilium were not involved. There was no sclerosis of bone. The lateral view showed definite evidence of destruction of the second sacral segment and a suggestion of destructive changes in the other segments. The conditions considered in the diagnosis were giant-cell tumor of the sacrum, osteolytic sarcoma, and osteomyelitis.

The child was readmitted to the Hospital and received three roentgen-ray treatments of 160 roentgen units each. The result was a decrease in pain in the back and the leg, and the tenderness and swelling of the sacrum disappeared entirely. Motions of the spine became free and painless. Roentgenographic examination of the chest gave negative results and the blood analysis revealed no anaemia. Because of the rapid subsidence of the swelling and the patient's clinical improvement after the roentgen-ray treatments, an endotheliomyeloma (Ewing's tumor) was suspected. Roentgenographic examination on August 24, 1935, showed an increasing destruction involving particularly the second sacral segment. An area of sclerosis surrounded the region of absorption. This factor also favored a diagnosis of endotheliomyeloma. Because of the necessity of using large doses of roentgen-ray therapy, a biopsy was considered advisable.

On August 27, 1935, the posterior surface of the sacrum was exposed through a small longitudinal incision. In stripping the thickened soft tissues from the bone, the cortex was easily fractured and the instrument entered a cavity in the sacrum. The cancellous bone in this region had been completely absorbed and the cavity was partly

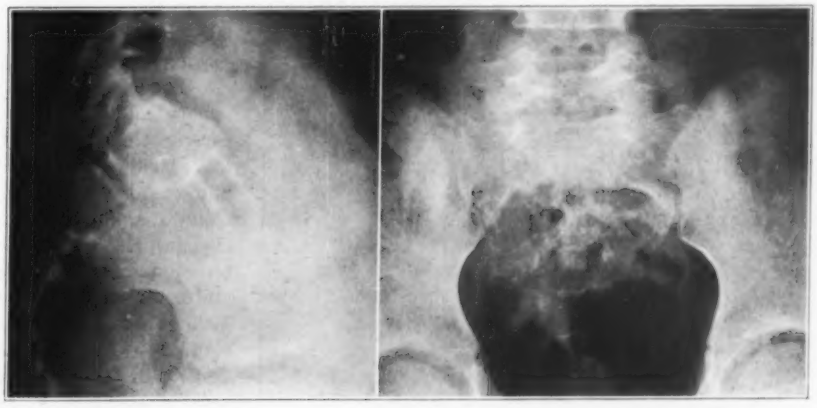

FIG. 3 FIG. 4

Roentgenograms, taken on August 6, 1935, showed an area of absorption and a bulging and thinning of the cortex over the lower two-thirds of the sacrum on the right side. The sacro-iliac joint and the ilium appeared normal. There was no bony sclerosis. The lateral view showed absorption, compression, and cortical irregularity, most marked in the second sacral segment.

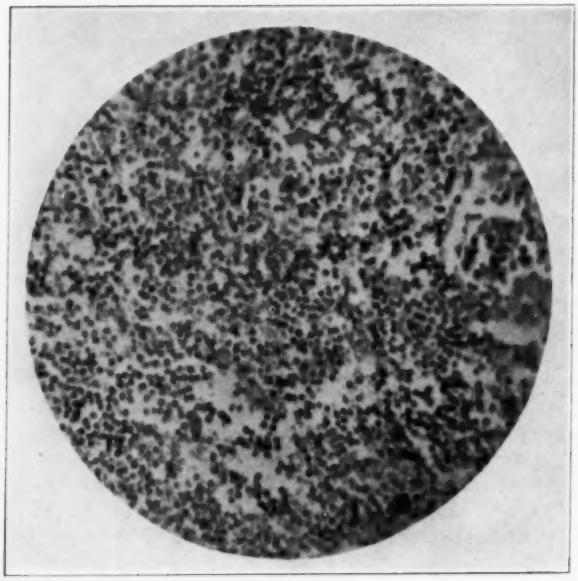

FIG. 5

Photomicrograph (× 120) showing closely packed cells with a large amount of intercellular stroma.

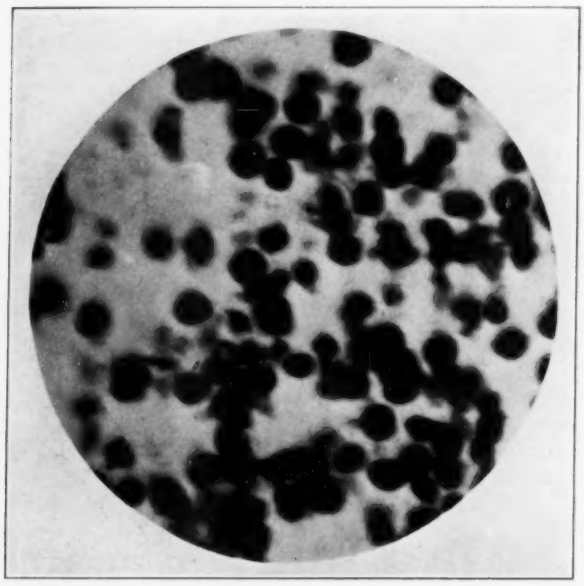

FIG. 6

Photomicrograph (× 510) showing the polyhedral cells with small, deeply staining, round or oval nuclei and scanty stainless cytoplasm. No multinucleated cells are seen.

filled with a grayish, gelatinoid material, some areas of which were of cartilaginous consistency. Specimens were removed for study.

The biopsy specimens (Figs. 5 and 6) were examined by Dr. Samuel Levine, and his examination revealed "a section of tissue with a large number of abnormal cells appearing in sheets and having a clear cytoplasm. The cells are polyhedral in shape and possess sharply defined borders. The nuclei are small, centrally located, and moderately hyperchromatic. The stroma is rich in connective tissue. Many of the nuclei contain nucleoli. No mitotic figures are observed. The tissue possesses a poor blood supply. The neoplastic cells have a haphazard arrangement and resemble endotheliomatous cells. Some of the cells are seen lying freely within the bone lacunae. No abnormal osteoblasts are observed. Diagnosis: Endotheliomyeloma (Ewing's tumor)".

The patient received twenty additional roentgen-ray treatments, a total of 5000 roentgen units. She was also treated with Coley's toxins. Roentgenographic examination on September 20, 1935, and again on October 16, 1935 (Figs. 7 and 8), showed some increased density in the area of involvement, but a considerable amount of rarefaction remained. Clinically the child's condition appeared to be improved. The wound

healed readily, there was no pain, and the mass did not recur. The patient was discharged from the Hospital on September 26, 1935.

On March 13, 1936, the child again entered the Hospital, complaining of weakness and pain in the legs, loss of appetite, and vomiting. A marked thickening was present over the posterior surface of the sacrum and in the lumbar region to the right of the mid-line. The abdomen was moderately distended. Enlargement of the veins about the umbilicus was noted. A firm, somewhat tender, fixed mass was palpable to the right of the umbilicus. An excess of fluid was present in the peritoneal cavity. Roentgenographic examination (Figs. 9 and 10) on March 2, 1936, showed increased bone formation in the sacrum, but in the lateral view a progressive destruction of the sacral segments was seen. The ilium was not involved. An intravenous urogram gave negative results. The leukocyte count was 20,400 and the polymorphonuclear count was 87

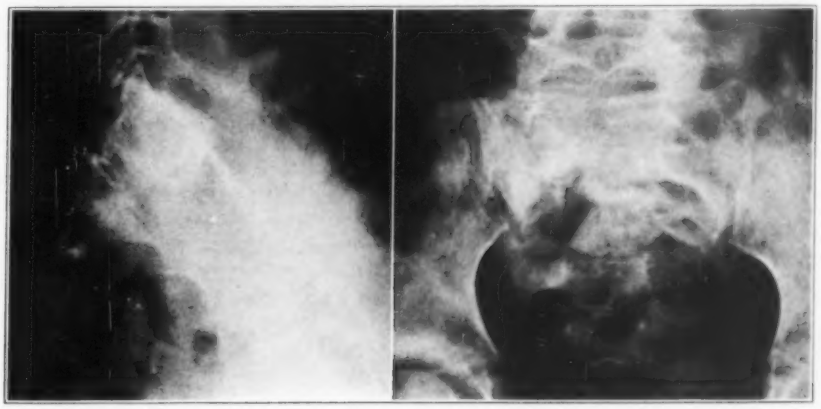

FIG. 7 FIG. 8

Roentgenograms, taken on October 16, 1935, showed an increased density in the right sacral wing, but considerable rarefaction was still present. The lateral view showed that the destruction had progressed. There was compression of all the sacral segments.

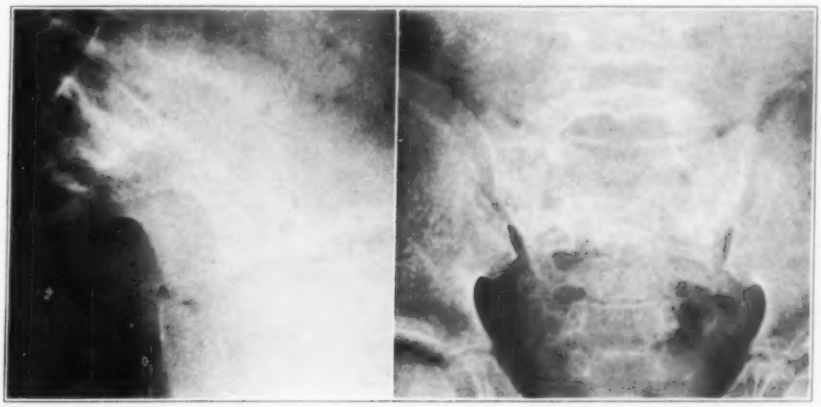

FIG. 9 FIG. 10

Roentgenograms, taken on March 2, 1936, in the anteroposterior view showed increased bone formation in the involved area of the sacrum with generalized surrounding sclerosis. The lateral view revealed greater destruction than was previously present. The ilium showed no involvement.

per cent. The patient became progressively weaker. She had attacks of nausea and vomiting, but complained of only occasional pain in the leg. The abdominal enlargement increased and the superficial veins became progressively distended. The mass in the right upper abdomen became very prominent. The patient began to complain of headache and abdominal pain. She died on May 30, 1936, during a convulsive attack.

Pertinent Post-Mortem Findings

The report of the post-mortem examination by Dr. David Fishback was as follows: "The cervical and axillary glands are enlarged. The pericardium contains an excess of light amber fluid. The left pleura contains 600 cubic centimeters of dark-brown fluid and the right a moderate quantity of grayish-white, blood-tinged fluid. Both lungs show partial atelectasis and there are small hemorrhagic infarcts in the lungs and the pleura. The inferior vena cava and the thoracic duct are surrounded by many fine, grayish lymph glands and are markedly compressed.

"The peritoneal cavity contains 200 cubic centimeters of grayish-white chylous fluid. The stomach and intestines are pushed forward by markedly enlarged retroperitoneal glands and by a firm grayish-white malignant mass, the size of a grapefruit, in the region of the left kidney and immediately below the spleen. The liver and the spleen are easily separated from this mass, but it is adherent to the left kidney, the pancreas, and the transverse and splenic flexures of the colon. The mesenteric lymph nodes are all markedly enlarged. Both kidneys are surrounded by a firm, grayish, malignant tissue and the adrenals are compressed. The pancreas is grayish-white, firm, and almost twice its normal size.

"The right portion of the sacrum is markedly softened and cuts readily. There is destruction of the sacrum adjacent to the right sacro-iliac joint. Within the sacrum there is a soft, dark-red tumor mass. A similar type of tumor tissue is also found in the right side of the fourth and fifth lumbar vertebrae. Apparently, there has been a direct extension of the tumor mass to the surrounding tissues and to the retroperitoneal glands. There is a reddish area of softened bone, apparently malignant, one by three centimeters, in the petrous portion of the right temporal bone.

"Histological examination of the tissue from the sacrum shows numerous polygonal cells having sharply defined borders with a small amount of clear cytoplasm and centrally located darkly staining nuclei. The abnormal cells appear in sheets. The cells are typical of Ewing's tumor. The tissue surrounding the adrenals shows a few muscle fibers separated by a diffusely infiltrating Ewing's tumor. Diagnosis: Endotheliomyeloma (Ewing's tumor)".

HODGKIN'S DISEASE OF THE BONES

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In recent years the literature has contained an increasing number of reports of cases of lymphogranulomatosis in which the classical findings of lymph-gland involvement, as first described by Hodgkin and the early writers, have been overshadowed by other manifestations. It is now becoming more evident that Hodgkin's disease may manifest itself in many different and bizarre ways.[1,2,3] Frequently the pathological changes may be first apparent in the osseous system, as illustrated in the following case presentation.

CASE REPORT

M. H., male, aged thirty-nine years, married, a janitor, complained of pain in the lower back. This condition had first been noted on May 20, 1936, immediately following a strain produced by carrying a heavy iron stove on the back down five flights of stairs. The patient applied home remedies with no relief of symptoms, and sought medical aid about seven weeks after onset of pain. He was treated at this time by another physician who prescribed baking to the lower back. Roentgenograms of the lower lumbar and sacro-iliac spine taken during this interval were reported as negative.

Since the patient was not improving, he changed physicians and was seen by the author on August 14, 1936, about three months after the initial injury. The pain in the lower back during this time had become marked, and, in addition, the patient complained of abdominal discomfort, poor appetite, and loss of about twenty-five pounds.

Physical examination showed that the patient had apparently lost weight. There was a slight tilt of the trunk to the left with bilateral spasm of the erector spinae, more marked on the left. Restriction and painful motions of the lower back, especially on forward and lateral flexion, were noted.

Marked tenderness was present along the second, third, fourth, and fifth lumbar vertebrae and the left sacro-iliac area. Straight-leg raising on the left was painful with the pain localized to the lower back. Straight-leg raising on the right was negative. Bilateral flexion of the thigh resulted in pain in the lower back. Reflex responses were normal. There were no sensory disturbances. The prostate gland was apparently normal.

Diathermy, infra-red radiation, and strapping of the lower back were instituted. The patient stated that he felt much better and that his appetite was improved. He was fitted with a sacro-iliac corset and received physiotherapy for three and one-half weeks.

Despite the fact that the patient believed that he was improving, clinical examination failed to show any decrease in the spastic appearance of the back. Roentgenograms were, therefore, ordered and the report was as follows:

"The roentgenographic examination of the lumbosacral spine shows irregular rarefaction and compression of the left side of the body of the third lumbar vertebra, with visible bony callus formation, indicative of a recent fracture."

Because of the history of loss of weight and the unusual type of trauma, the author was suspicious of a pathological fracture as the result of a neoplasm. However, the roentgenologist doubted the possibility of a malignant growth because of the presence of the bony callus in the roentgenogram.

The patient was, therefore, placed in a plaster-of-Paris jacket with the spine flexed to the right.

There was no apparent change following this procedure. The patient continued to have gastric disturbances, although no further loss of weight occurred. He was then in-

FIG. 1-B

FIG. 1-A

Anteroposterior and lateral roentgenograms of the lumbar spine, showing destruction in the third lumbar vertebra.

structed to take his temperature several times during the day. This revealed a daily rise of 99.2 to 100.8 The possibility of either osteomyelitis or tuberculosis of the spine was then entertained.

After a month, during which no improvement had been noticed, the plaster-of-Paris jacket was removed, and examination showed spasm of the left erector spinae muscle. The area about the third lumbar vertebra on the left was very tender and painful. Tenderness was likewise present in the lower lumbar and sacro-iliac areas. There was a painful nodule palpable in the abdomen slightly above Poupart's ligament on the left. No evidence of any mass was felt in the abdomen, although some tenderness was present around the left side of the umbilicus and the left loin. Hypaesthesia was present on the left lower abdomen and the left lower extremity. There was slight exaggeration of both knee and ankle reflexes.

Measurements of the lower extremities were as follows:

Right thigh	17¾ inches
Left thigh	15⅞ inches
Right calf	12⅞ inches
Left calf	12¼ inches

Additional roentgenograms were then ordered, which showed an increase in the destructive process associated with luxation of the left inferior articulating process of the third lumbar vertebra with decrease of the evidence of callus formation previously reported.

The condition appeared to be a chronic infectious process, either osteomyelitis or tuberculosis. The patient was, therefore, hospitalized, and further study and treatments were continued with the collaboration of Dr. Leo Mayer.

On the morning prior to entering the hospital, the patient experienced sharp shooting pains in the left loin and the left lower extremity, following which he was unable to extend the left hip completely. Examination showed limitation of extension of the left hip to 160 degrees with some fullness in the left lower abdomen about the iliopsoas region. The patient was then placed on a convex frame and traction applied to the left lower extremity.

The blood count on the day of admission was as follows:

Red blood cells—3,680,000
Hemoglobin—60 per cent.
White blood count—14,400
Neutrophiles— 69 per cent.
Eosinophiles— 3 per cent.
Lymphocytes—28 per cent.

The Wassermann and Kahn tests were negative. The temperature varied between 98.9 and 100 degrees, and the pulse rate varied between 70 and 90 per minute. The differential tuberculin test showed slight reaction in the dilution of 1 to 10,000, but was negative in higher dilutions.

Further roentgenograms showed spreading of the destructive processes in the spine. The roentgenograms of the skull and the chest were negative.

Diagnosis: Neoplasm of the spine (hemangioma?).

Showing no improvement, the patient was then taken to the operating room for biopsy of the left inguinal glands.

The operative procedure performed on October 20, 1936, two weeks after admission, was as follows: A three-inch incision was made in the left groin. A mass of enlarged lymph nodes was found and three of them were removed. When split longitudinally, their gross appearance showed no particular abnormality. While frozen sections were being made, the incision was deepened through Poupart's ligament, exposing the psoas iliacus muscle. The fibers were separated bluntly until the posterior surface of the muscle was reached. No abscess or tumor mass could be demonstrated. The muscle fibers were spastic and gave the impression of a swelling which disappeared as the muscle fibers were retracted. The report of the frozen section was negative for tumor. The incision was closed with a subcutaneous stitch and dermol for the skin.

Pathological examination of the specimen, of which several sections were taken, was as follows:

Gross: "Specimen consists of a group of inguinal lymph nodes which are discrete, slightly enlarged, and on section present a yellowish-brown appearance."

Microscopic: "Serial sections of the incised lymph nodes show only chronic non-specific inflammation with some fibrosis, which probably has no relation to the lesion in the spine."

Diagnosis: "Chronic non-specific lymphadenitis. No evidence of malignancy."

No definite diagnosis was possible even after two weeks of study and following biopsy of the glands.

It is of interest to bear in mind the absence of any pathological findings within the iliopsoas muscle, except for the slight spasticity present.

On October 27, 1936, an exploratory operation was performed on the spine. A four-inch mid-line incision was made vertically, with its center corresponding to the spinous processes of the third lumbar vertebra. The spinous processes and the laminae of the second, third, and fourth lumbar vertebrae were exposed on the left side only. By strong retraction it was possible to expose the lateral processes of the second and third lumbar vertebrae. The lateral process of the second was removed first. Then the dissection was continued downward toward the third. During this dissection, an area of abnormal tissue was exposed. This was deep yellow in color, had the consistency of a thick custard, and had invaded the lateral process and the lamina of the third lumbar vertebra. About a thimbleful of this tissue was removed, together with the surrounding bone. A frozen section was taken at once, which showed no definite tumor cells. Further exploration failed to reveal the presence of any pus. The wound was closed in layers, using dermol for the skin.

Pathological examination of the specimen, of which a number of representative sections were taken, was as follows:

Gross: "Specimen consists of a number of soft, friable, yellowish, irregular fragments of soft tissue, about one centimeter in diameter. A few of the fragments include thin spicules of bone."

Microscopic: "Sections show an inflamed granulation tissue containing collections of lipophages and densely infiltrated by polynuclear leukocytes, plasma cells, macrophages, and eosinophiles. There are scattered areas of necrosis present. The tissue shows conspicuous proliferation of reticulocytes and histiocytes, some of which present evidence of active phagocytosis."

Diagnosis: "Fragments of granulation tissue, rich in lipophages, showing chronic and acute inflammation. The histological picture suggests a chronic low-grade infection with a recent exacerbation."

Cultures of the tissue were negative. After all these examinations and studies, a definite diagnosis could not be made.

The patient's condition became more grave. He was unable to eat most foods and lost weight. He complained of considerable pain in the lower back and showed a progressively increasing anaemia with elevation of the white blood count.

The laboratory findings on three different occasions were as follows:

November 18, 1936

Hemoglobin—58 per cent.

December 1, 1936

Red blood cells—2,480,000
Hemoglobin—42 per cent.
White blood cells—16,300
Neutrophiles—90 per cent.
Eosinophiles— 1 per cent.
Lymphocytes—9 per cent.

December 7, 1936

Red blood cells—2,848,000
Hemoglobin—45 per cent.
White blood cells—25,200
Neutrophiles—94 per cent.
Lymphocytes— 6 per cent.

Several autogenous blood transfusions were given, with no improvement of the blood picture.

Large axillary glands on the right were noted for the first time on December 15, 1936, as well as the marked increase in size of the glands in the left inguinal region and, also, on the right inguinal area.

On December 15, 1936, under local anaesthesia, a two-inch transverse incision was made over the enlarged lymph nodes. These presented as a mass of seven or eight greatly enlarged nodes, several of them showing caseous degeneration. They were easily removed and the incision was closed with a fine cat-gut subcutaneous stitch and dermol for the skin.

Pathological examination at this time was as follows:

Gross: "Specimen consists of a matted mass of lymph nodes which vary in diameter from one to four centimeters. There are rather dense fibrous adhesions binding the lymph nodes together. The latter are firm in consistency and, on section, show a rather cellular homogeneous grayish-yellow appearance. Some of the nodes show focal yellowish-brown areas of fibrosis and apparent hyalinization."

Microscopic: "Sections show a marked proliferation of large atypical cells with pale cytoplasm, apparently of reticular origin. There are many multinuclear cells and numerous mitotic figures. The stroma is infiltrated by many inflammatory cells, principally polynuclear leukocytes with plasma cells and eosinophiles as well. Some of the lymph nodes show a definite tendency to fibrosis and hyalinization. The histological picture suggests Hodgkin's disease in a very active stage with an atypical anaplastic proliferation of reticulocytes."

Diagnosis: "Hodgkin's disease."

The patient died on December 22, 1936.

Post-mortem examination showed an extensive spread of the disease with considerable involvement of the abdominal and pelvic glands, which had produced partial obstructions about the head of the pancreas and distension of the gall bladder. There was partial obstruction of the ureters at their entrance into the bladder. The spleen was not enlarged, but showed a few small involved areas. The ribs, the sternum, and the thoracic, lumbar, and sacral spine revealed involved areas not visible roentgenographically. The left psoas muscle was almost entirely replaced by this pathological process. The mediastinal glands were only slightly involved.

SUMMARY AND CONCLUSIONS

This case presentation is of import chiefly because it shows that Hodgkin's disease with involvement of the osseous system is not a rare condition, and that its possibility must be borne in mind. It shows also that, because of the bizarre manifestations of the disease and the occasional absence of superficial gland involvement, diagnosis may be quite difficult.

Hodgkin's granuloma is primarily a disease of the reticulo-endothelial system, perhaps of an infectious origin, at times with secondary osseous invasions, resulting in either osteolytic or osteoblastic bone manifestations.

Sincere thanks are extended to Dr. Henry Jaffe, Director of the Laboratory of the Hospital for Joint Diseases, for his kind assistance and interest in the handling of this case.

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THE OPERA-GLASS HAND IN CHRONIC ARTHRITIS

"*La Main en Lorgnette*" of Marie and Léri

BY LOUIS S. NELSON, M.D., BROOKLYN, NEW YORK

From the Jewish Sanitarium Hospital for Chronic Diseases *

The object of this paper is to call attention to a rare deformity of the hands occurring in chronic rheumatic disease. The deformity is characterized by telescoping of the fingers produced by absorption of the phalanges; with the absorption of the skeletal supporting structure and the maintenance of the soft parts, transverse folds occur in the excess skin, giving a pawlike appearance to the hand.

Because of this telescoping, Marie and Léri named this condition "*la main en lorgnette*", or the opera-glass hand. In 1913, they described the autopsy findings in the case of a female, seventy years old, suffering from chronic rheumatic disease and presenting this curious deformity. Nothing further in regard to this condition appeared in the literature until 1929, when Weigeldt reported a similar case of chronic polyarthritis with progressive shortening of the fingers, while the skin remained unaffected, producing the transverse folds typical of "*la main en lorgnette*".

When one considers the tremendous number of arthritics found in all countries, it is indeed surprising that the world literature on this subject should be so scant. The following report of a case of chronic rheumatic disease presenting the opera-glass hand is unusual in that this condition occurred in a woman of thirty-one, whereas in the case reported by Marie and Léri the patient's age was seventy, and in the case described by Weigeldt the age of the patient was sixty-four years. In other respects, the similarity of the present case to those reported by the previous authors is striking.

The patient, a white female, thirty-one years old, was admitted to the Hospital for Chronic Diseases in April 1929. At that time, the chief complaints were stiffness in most of the joints, weakness, and deformity of the hands.

The family history, past history, and all the systems were entirely negative.

The patient had been a perfectly healthy and normal child until the age of twelve, when pain had developed in the fingers. The pain was of a sticking character, and the fingers felt stiff every morning, but this passed away as the fingers were manipulated. Several weeks later, the knees became swollen, painful, and stiff. Later the ankles were similarly affected. The patient received a variety of treatments, but grew progressively worse. About one year later, she was admitted to the Roosevelt Hospital where a diagnosis of Still's disease was made. Progressive joint involvement and stiffness continued until she was completely bedridden. The hip joints became involved about nine months after the original onset. The arthritic condition was slowly progressive with accompanying atrophy of all of the muscles and marked weakness and stiffness.

While at the Sanitarium, she had been subject to frequent infections of the upper

* Orthopaedic Service of B. Koven, M.D.

FIG. 1

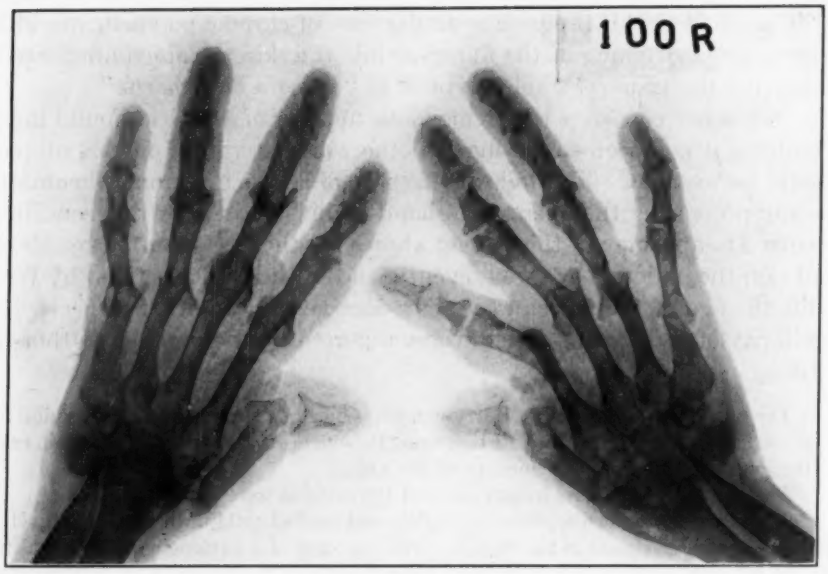

FIG. 2

respiratory tract, but she had had no serious illnesses until January 1932, when a mass had developed in the right hypochondrium, which was diagnosed as a perinephritic abscess. Roentgenographic examination revealed a large calculus in the right kidney. A partial nephrectomy was done. The specimen showed chronic purulent pyonephritis with fibrosis of the parenchyma, and a large renal calculus. The wound drained for several weeks, but was completely healed ten weeks after the operation. In June 1932, a profuse mucopurulent discharge from both eyes developed. A definite diagnosis of

trachoma with corneal complications was made. The disease was extremely active in spite of intensive treatment.

Physical examination showed a white female, markedly undernourished and underdeveloped, with atrophy of the extremities. She was completely bedridden and practically unable to move except for slight ranges of motion at the shoulders and the elbows. Mentally, she was well oriented and cooperative.

The positive findings were a seborrhoeic dermatitis in the head and chronic conjunctivitis with corneal opacities of the eyes. Scoliosis and stiffness in the spine were noted, as well as complete ankylosis of both hips and knees.

The hands revealed the characteristic deformity of "*la main en lorgnette*". All the fingers were foreshortened. On the right, the thumb and forefinger were markedly telescoped in typical fashion with transverse folding of the excess skin easily seen in Figure 1. An abnormal degree of mobility was present. The other fingers showed telescoping to a less extent. The little and ring fingers exhibited ankylosis at the interphalangeal joints, but were relatively shortened, due to the absorption of the metacarpals. The skin of the finger tips was reddened, hyperaemic, and glossy.

Roentgenograms of the hands (Fig. 2) were strikingly similar to those of the two previously published cases. The right hand presented absorption of the proximal phalanx of the thumb and the adjacent half of the metacarpal. The base of the distal phalanx was absorbed. The second finger showed absorption of half of the shaft of the middle phalanx. The remaining base was ankylosed to the proximal phalanx. The second metacarpal was thinned out and rounded as though dissolved. The knuckle joint had completely disappeared and the finger was telescoped. The third finger showed a similar condition. The proximal phalanx of the fourth finger was in the process of solution. The knuckle joint was telescoped with rarefaction of the bone at the base. The little finger showed ankylosis of the interphalangeal joint, with absorption of more than one-half of the shaft of the metacarpal and the base in the process of solution.

The ulna had been dissolved so that it tapered to a long, thin cone. The carpal bones and adjacent radius were irregularly fused, much of the bone having been dissolved.

In the left hand, a similar solution of the shaft of the phalanges was present, especially marked at the knuckle joints. Here, too, the end of the ulna was cone-shaped. The carpal bones were mostly dissolved, and the whole area was fused irregularly.

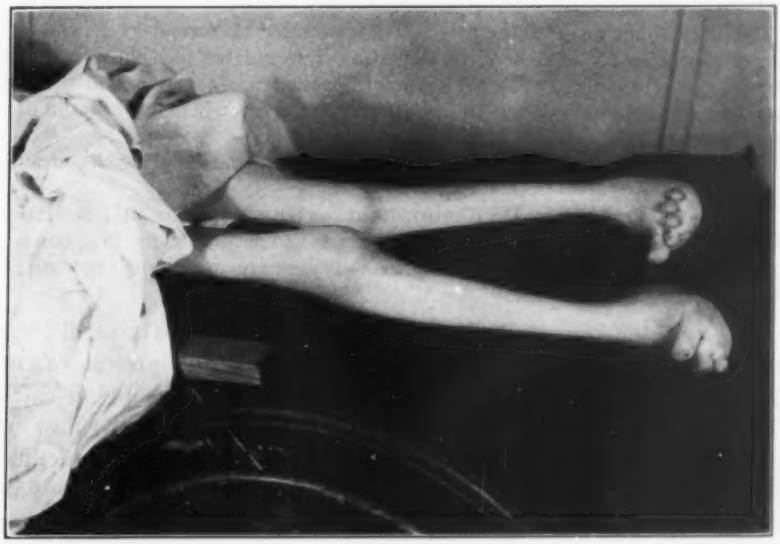

FIG. 3

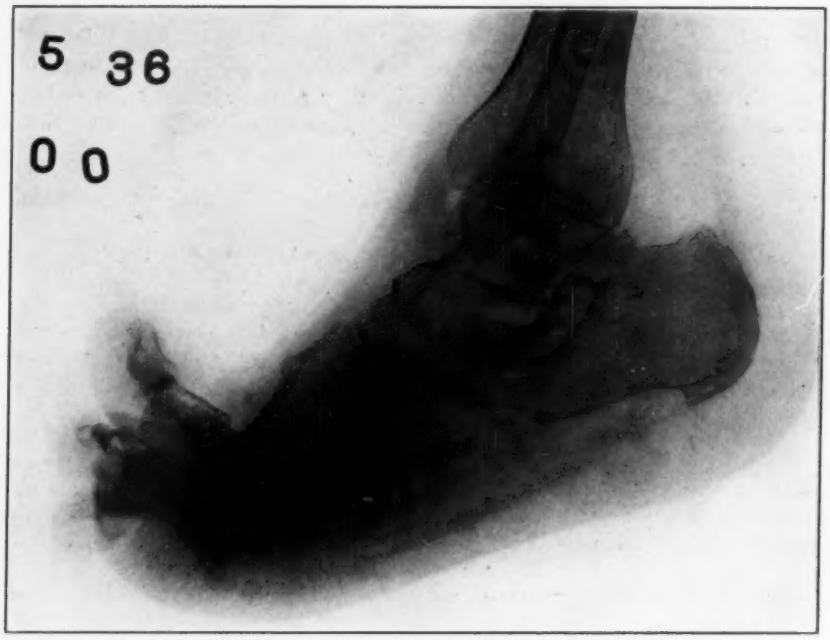

FIG. 4

Both of the ankles were fused in an equinus position (Fig. 3). The feet presented irregular absorption of the metatarsals. Figure 4 shows absorption of the head and adjacent shaft of the first metatarsal of the right foot, with a rounded cone-shaped residual portion. The second metatarsal was tapered to a long thin cone. The heads of the third and fourth metatarsals were in the process of absorption and the head of the fifth showed complete absorption with tapering of the residual shaft. The phalanges also exhibited irregular absorption. The tarsal bones were irregularly fused, and some of them were partly absorbed.

The blood count revealed the presence of a considerable secondary anaemia. The serum calcium was 10.7; the serum phosphorus, 2.9 and the phosphatase, 3.6 units. These are normal findings. The Wassermann reaction was negative, and the test for rheumatoid arthritis was positive in agglutination of specific hemalytic streptococci in dilution of 1 to 1200.

While the patient was under observation, bronchopneumonia developed and she died.

At autopsy, performed by Dr. Kantrowitz at the Beth Moses Hospital, a parathyroid adenoma was discovered. The bones of the hands and several of the long bones were examined; these showed no abnormal changes. There were no abnormal changes in any of the other glands of the body.

The relationship of the parathyroid adenoma and possible hyperparathyroidism to the absorption of bone in the hands provides food for speculation. If we are to consider that during life the blood calcium, phosphorus, and phosphatase were all normal, this would rule against hyperactivity of the parathyroids. The presence of a renal calculus, of bone absorption, and of osteoporosis of bone would possibly indicate parathyroid activity during life. The mere presence of the parathyroid adenoma is presumptive evidence in favor of hyperparathyroidism, but

we can only speculate as to the production of bone absorption resulting in *"la main en lorgnette"*. We have no positive proof of their connection. During the life of this patient, no diagnosis of hyperparathyroidism had ever been made, nor had the presence of adenoma ever been suspected.

Gutman, Swenson, and Parsons reported a case in which the terminal phalanges were absorbed during the state of hyperparathyroidism. After the removal of the parathyroid adenoma, there was reduction of the phosphatase and serum calcium, resulting in recalcification of the phalanges.

The author wishes to thank Dr. Bodansky and Dr. Jaffe of the Hospital for Joint Diseases for valuable laboratory assistance and Dr. Kantrowitz of the Beth Moses Hospital for his excellent work at the autopsy table.

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A TURNBUCKLE LUG FOR WEDGING JACKETS FOR SCOLIOSIS

BY NICHOLAS J. GIANNESTRAS, M.D., CINCINNATI, OHIO

From the New York Orthopaedic Dispensary and Hospital

Wedging-jacket correction of lateral curvature of the spine has been employed at the New York Orthopaedic Dispensary and Hospital, as described by Hibbs, Risser, and Ferguson.[1] Formerly, the turnbuckle lugs were incorporated into the plaster at the time of the application of the jacket. At a later date, incorporation of the lugs into the jacket was discontinued, as it was found that the lugs could be placed more accurately at the time that the wedge was cut out of the jacket, and the cast itself was neater in appearance. Various types of lugs have been tried out from time to time. The one herein described and illustrated has overcome the difficulties experienced with the lugs previously used. The type used prior to the present one had five component parts, and the application required anywhere from fifteen to thirty minutes. Furthermore, due to the varying thickness of the jacket, the bolts used either projected inwardly, causing discomfort to the patient, or outwardly above the external surface of the wedging jacket, catching into the bed linen and thus tearing it. Of course, the thickness of the plaster will vary with the size of the patient and the technique of its application. At this Hospital the average jacket is from three-quarters of an inch to one inch thick. The new hinge lug is so constructed, however, that it will accommodate itself to

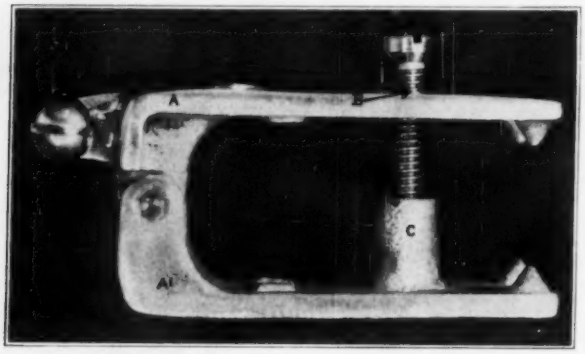

FIG. 1
Showing the construction of the lug.

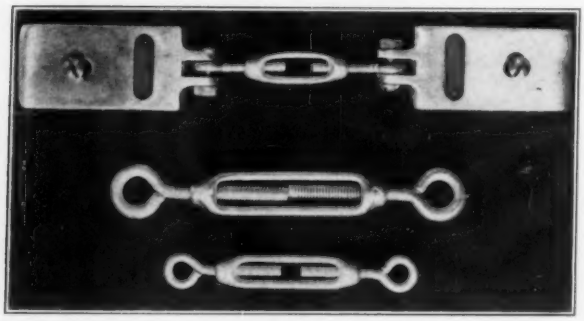

FIG. 2
Illustrating the two lugs and the three sizes of turnbuckles which are most often used.

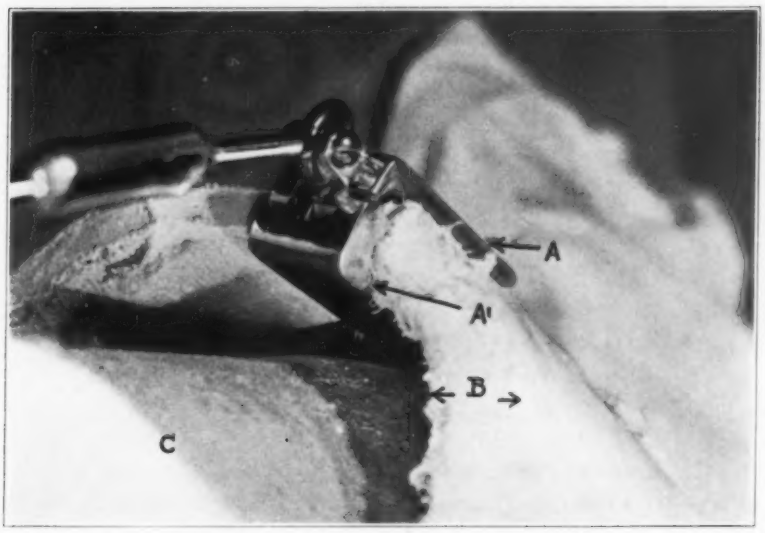

FIG. 3
Showing the application of the lug:
A: Upper arm of hinge;
A': Lower arm of hinge;
B: Edge of cast;
C: Patient's body.

any jacket varying between one-half and one and one-half inches in thickness.

The lug shown in Figure 1 is made of aluminum, cast in the form of a hinge, and the two bolts and one nut are of stainless steel. Therefore, the entire assembly is rustproof and in spite of its lightness can withstand a shearing stress of 100 pounds as determined by the manufacturer. *A* and *A'* are the arms of the hinge. *B* is a bolt which fits through a slot in the upper arm of the hinge and can thus be fed into the sleeve, *C*, which, in turn, is part of the lower arm of the hinge. At the distal end of each arm there are two projections which, when the hinge is screwed down, sink into the jacket and thus prevent any lateral motion. Figure 2 illustrates the two lugs and the three sizes of turnbuckles most often used. The slots into which the turnbuckles fit are wide enough to accommodate one of larger size if the necessity should arise.

METHOD OF APPLICATION

After the wedge has been cut out of the jacket on the convex side of the primary curve and the opposite half of the jacket has been cut transversely to the apices of the wedge previously cut, the jacket is pried apart approximately four inches, in the direction necessary to correct the primary curve, to allow for the insertion of the lugs and the turnbuckle. Next, a hole, one-half an inch in diameter, is drilled through the cast one and one-quarter inches from each cut edge of the jacket with a half-inch bit and any type of auger which will hold the bit. The lug is then applied as

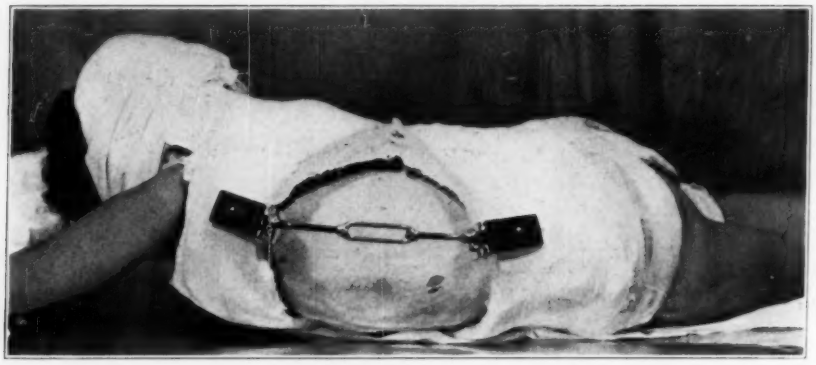

FIG. 4
Illustrating jacket at time of wedging, and the lugs and turnbuckle in use.

follows: The arm of the hinge labelled *A'* in Figure 1 is introduced under the inner edge of the jacket, as illustrated in Figure 3, the sleeve fitting into the hole previously drilled. The arm *A* is then closed down on the outer surface of the jacket, and the bolt *B* is fed into the sleeve and screwed down until the projections bite into the cast firmly and the bolt cannot be screwed down any further. Thus, at the end of this procedure, the hinged lug is tightly in place, and, as seen in Figures 3 and 4, no portion of the mechanism projects either inwardly or outwardly, but the surfaces are perfectly flat.

Because of the simplicity of the application of both lugs and the turnbuckle, the time required for the assembly and application is seldom more than five minutes. The apparatus has been used exclusively since its introduction six months ago at the New York Orthopaedic Dispensary and Hospital and has been found practical and very satisfactory.

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TWO RARE DISLOCATIONS OF THE METATARSALS AT LISFRANC'S JOINT

BY EDWARD RAYMOND EASTON, M.D., F.A.C.S., NEW YORK, N. Y.

Since dislocations of the tarsometarsal joints are seldom reported in the literature, the following cases may be of some interest. According to the classification of Quénu and Küss, they belong to the spatular and to the divergent type, respectively. An example of the latter was reported by Ashhurst in 1926.

CASE REPORTS

CASE 1. *Spatular Dislocation without Fracture.*

N. M., female, thirty-eight years of age, fell down two steps, on April 23, 1937, twisting the forepart of the right foot beneath her. The foot was not caught in any vise-like grip, but the last four metatarsals received the whole impact of her weight. On being helped up, the patient was unable to walk.

When seen by the writer, the foot was considerably swollen and oedematous, with several small blebs and abrasions on the dorsal surface. There seemed to be an unusual prominence of the base of the fourth metatarsal dorsally and externally and a shortening of the foot lengthwise. A roentgenographic examination was made by Dr. W. H. Boone, of Roosevelt Hospital, who made a diagnosis of lateral slipping of the second, third, fourth, and fifth metatarsal bones of the right foot at their proximal articulations, without fracture. The cuboid and external cuneiform appeared to be displaced somewhat inwardly.

The foot was elevated and an alum-acetate wet dressing was applied for three days, at the end of which time the patient was taken to the office of Dr. J. J. Nutt, orthopaedic surgeon at the Polyclinic Hospital. The swelling and discoloration had disappeared to a marked extent, but the deformity was still evident. Dr. Nutt placed the foot in a position of equinovarus, without anaesthesia, and applied a stirrup splint of molded plaster. Roentgenographic examination on the following day showed excellent alignment and apposition of the tarsal and metatarsal bones.

After three weeks, the plaster splint was removed, and the foot was strapped in a position of adduction and inversion. This was repeated weekly for about five weeks, and at the end of that time the foot was normal in appearance, required no further support, and had regained its full functions. The patient, a professional entertainer, was able to perform an intricate dance which she could not have done without perfect use of her foot.

CASE 2. *Divergent Luxation.*

J. L., a schoolboy, aged nine, was knocked down by an automobile on May 30, 1937, his left foot being caught under the wheel. At Knickerbocker Hospital the foot was elevated and dry heat was applied. Roentgenographic examination showed a longitudinal fracture of the navicular, irregular fractures of the internal, middle, and outer cuneiforms, a longitudinal fracture of the cuboid, and irregular fractures of the bases of the second, third, and fourth metatarsals. All these fractures were entirely without displacement of fragments. Apparently the wheel had passed over Lisfranc's joint in a transverse direction. The roentgenogram also revealed a dislocation of all of the metatarsals: the first was displaced inwardly at its base; the four outer ones, externally and dorsally.

When first seen by the writer, there was marked swelling in the region of the tarsometatarsal joint, with blebs and ecchymosis. There was a prominence on the medial aspect of the foot, due to the inward displacement of the first metatarsal, and a corresponding prominence outward and upward over the displaced bases of the second, third, and fourth metatarsals. The entire foot appeared to be shortened.

FIG. 1-A

Case 1. Anteroposterior view, showing lateral slipping of the second, third, fourth and fifth metatarsals of the right foot.

FIG. 1–B

Lateral view of right foot, showing displacement of the cuboid and of the external cuneiform, as well as of four metatarsals.

FIG. 1–C

Right foot encased in a plaster stirrup in the equinovarus position. The relation of the bones is restored to normal.

FIG. 2–B

Anteroposterior view of the left foot after reduction.

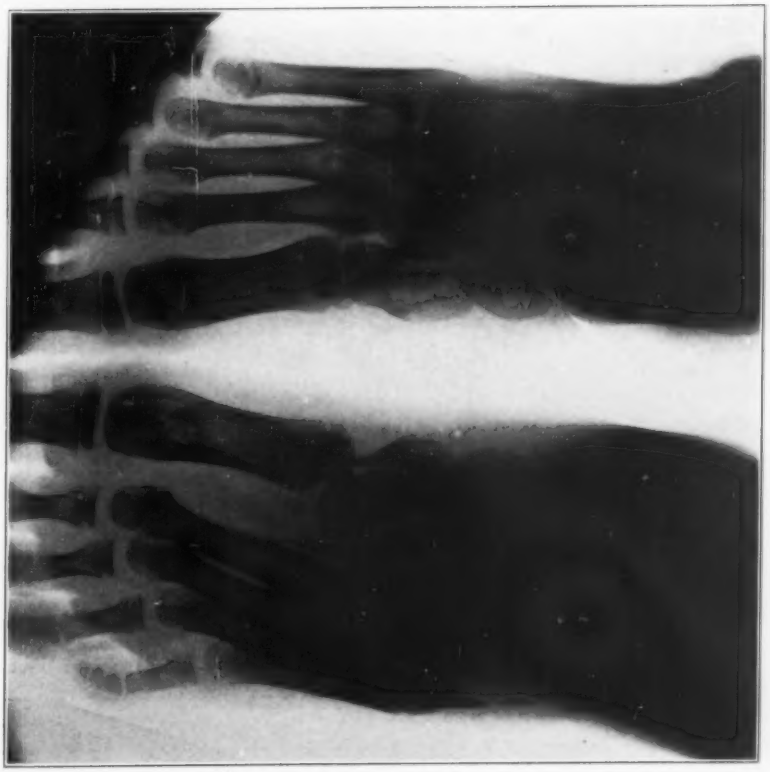

FIG. 2–A

Case 2. Anteroposterior view of both feet, showing multiple fractures of the tarsal and metatarsal bones and divergent dislocation of Lisfranc's joint of the left foot.

Wet dressings of alum-acetate were applied and elevation of the foot was continued, but on June 11 the roentgenograms still showed an abnormal space between the first and second metatarsals. Closed reduction was attempted, but this failed to improve the luxations. Therefore, on June 22, an open operation, similar to that described by Ashhurst, was carried out under tourniquet as follows:

Under ether anaesthesia, a bayonet-shaped incision was made from the insertion of the peroneus brevis tendon on the lateral border of the foot, extending medially across the dorsum, and downward along the interspace between the fourth and fifth metatarsals. The bases of the four outer metatarsals were found to be luxated dorsally and laterally on the cuneiform bones, confirming the roentgenographic findings. After the soft parts had been elevated from the dorsum of the foot, reduction was secured by leverage over a curved periosteal elevator. Reduction was maintained, making it unnecessary to transplant the peroneus brevis tendon as was done in Ashhurst's case. A second incision was then made longitudinally along the medial side of the tibialis anterior tendon and continued downward over the medial surface of the first metatarsal. The base of the first metatarsal was found riding on the dorsal and medial surfaces of the internal cuneiform bone. Reduction was easily secured, with no recurrence, making it unnecessary to suture the base of the first metatarsal to the internal cuneiform.

The foot was placed in the equinovarus position and dressed with plaster-of-Paris. A roentgenogram, taken after this procedure, showed that the four outer metatarsals were in their normal position. However, there was still present some increased space between the first and second metatarsals. The sutures were removed on the twelfth day, and the wounds remained clean. On the eighteenth day, the plaster splints were removed, and baking and massage were started. It was noted that the patient had not yet attained full control in dorsiflexion of his four outer toes, and that the foot was inclined to slip back into the equinovarus position. After fluoroscopic study of the foot, a posterior molded splint was applied to correct the equinovarus, and physiotherapy was continued.

The splint was removed three weeks later, and the patient began to use the foot. On September 6, examination showed free movement at the ankle and subastragalar joint and full movement of the toes in all directions, but the mid-portion of the foot was entirely immobile, apparently due to an overgrowth of callus at the sites of the numerous fractures. There was no pain on palpation or attempted movement of Lisfranc's joint, and no apparent deformity of the foot was noted except for a slight protuberance on the dorsal surface over the bases of the third and fourth metatarsals, due to the bony overgrowth. The arches were completely preserved, and the patient walked without a limp.

The end results appeared so favorable that the patient was discharged, with instructions to the mother to continue contrast baths and to allow free use of the foot in running and in playing.

Reduction in these cases is usually secured without difficulty. Speed recommends immediate traction on the toes; this may have to be done under anaesthesia if the foot is tender and swollen. Should this not prove successful, open operation must be performed. Judging from the results in the two cases reported here, the prognosis for such injuries is very good.

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A WIRE TIGHTENER

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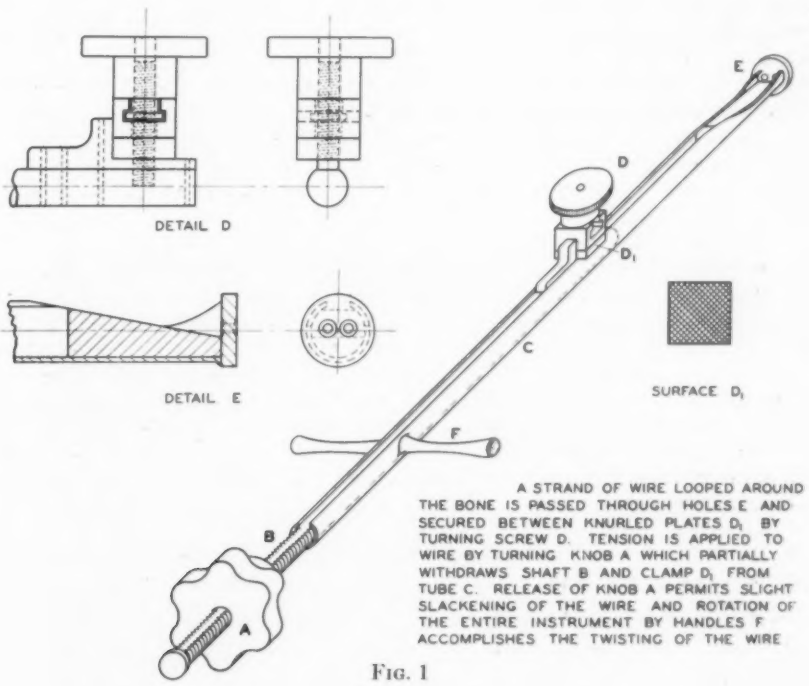
Wire as a means of holding bone-fragment surfaces together in close approximation has been used for many years. However, the mechanical efficiency of this type of fixation has often been far from ideal, for it is technically difficult to oppose and to fix bone fragments with wire by using pliers or the wire tighteners now available on the market.

In order to overcome these difficulties, the instrument here presented was designed. The principle of the Parham-band tightener was utilized to this end.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SURFACE D_1
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B
A
A STRAND OF WIRE LOOPED AROUND THE BONE IS PASSED THROUGH HOLES E AND SECURED BETWEEN KNURLED PLATES D_1 BY TURNING SCREW D. TENSION IS APPLIED TO WIRE BY TURNING KNOB A WHICH PARTIALLY WITHDRAWS SHAFT B AND CLAMP D_1 FROM TUBE C. RELEASE OF KNOB A PERMITS SLIGHT SLACKENING OF THE WIRE AND ROTATION OF THE ENTIRE INSTRUMENT BY HANDLES F ACCOMPLISHES THE TWISTING OF THE WIRE

FIG. 1

The instrument is relatively simple in construction and in operation. The wire is passed around or through the bone fragments as the case may be, and the free ends are approximately equalized in length. The ends are now passed through the holes shown in *Detail E* of Figure 1 and are easily secured and pulled through, as the inclined surface immediately above the plate automatically points the wire ends upward. Knob *D* is then unscrewed, thus elevating the upper knurled plate. The wire ends

are placed between the two plates (D_1) and knob D is tightened. This firmly secures the wire in the instrument. Knob A is then turned sufficiently to obtain optimum apposition. Here care must be exercised not to apply undue tension, as breaking of the wire may ensue even though the stress is only linear in type. A little preliminary practice will give the operator the necessary experience to enable him to judge the strain to which a given wire may be subjected. Knob A is released about 90 degrees, or slightly more,—that is, no more than to allow just sufficient slack to permit the wires to cross each other when the whole instrument is turned by handle F. Further gradual relaxation of knob A will permit gradual completion of as many twists as desired. After the first two complete twists, it is best to apply a hemostat or narrow pointed pliers to the already twisted portion of the wire before further turning is carried out. The heavier the wire used, the more primary relaxation of knob A is necessary before accomplishing the first securing twist.

FIG. 2

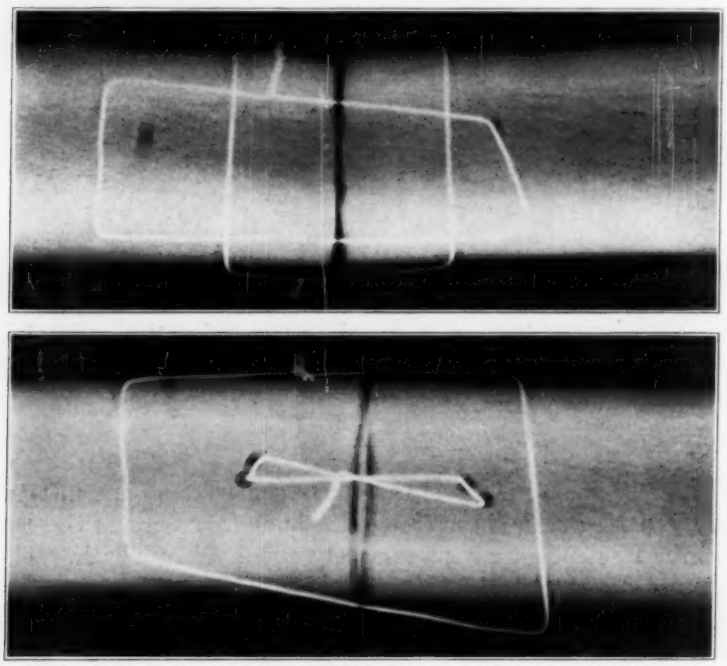

FIG. 3

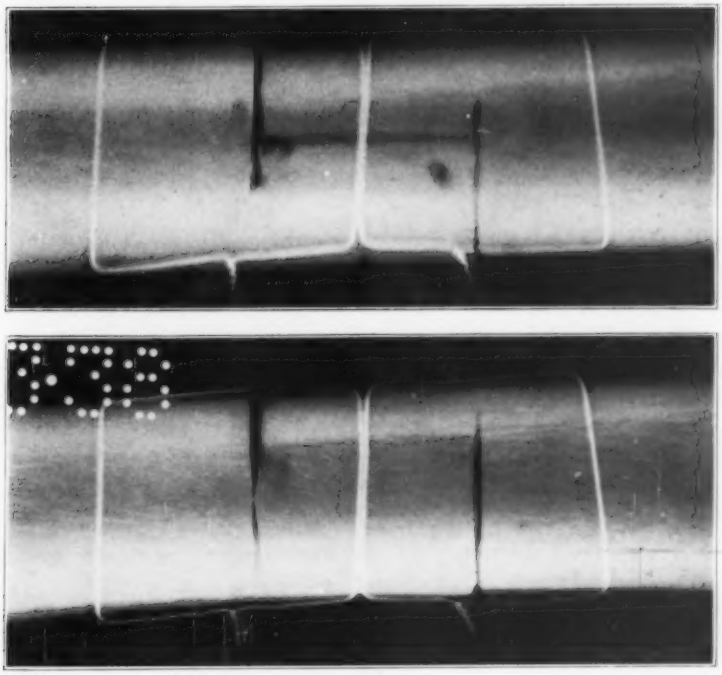

FIG. 4

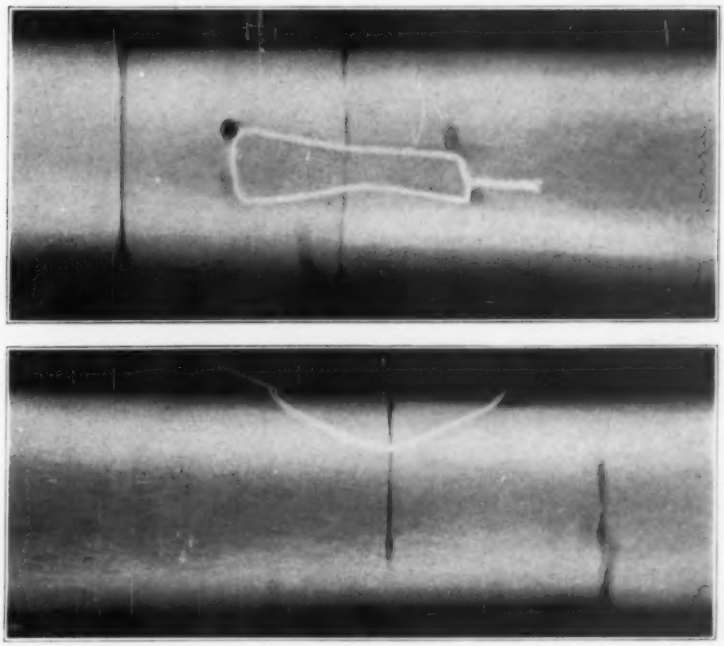

FIG. 5

Figure 2 shows the instrument still attached at the end of this operation. The absolute proximity of the first turn to the bone surface and the close approximation of the fragments are noteworthy.

The variety of loops that one may employ will depend, of course, on the type of bone fragments with which the operator has to contend. Figures 3, 4, and 5 show a few x-rays with a variety of loops to suit the fragments.

This efficient, relatively simple instrument for wire tightening is presented with the hope of aiding the surgeon in proper bone-fragment fixation when that is sought.

ACUTE MICROCOCCUS CATARRHALIS ARTHRITIS

BY WALTER M. SOLOMON, M.D., AND HENRY R. TUCHEWICZ, B.S., CLEVELAND, OHIO

From the Departments of Medicine and Pathology of Western Reserve University at Cleveland City Hospital, Cleveland, Ohio

Micrococcus catarrhalis (Neisseria catarrhalis) is rarely considered a serious pathogenic organism, although it is frequently found in the upper respiratory tracts of normal individuals. During the past twenty years, a few publications in the foreign literature have reported this organism as the etiological agent in such diseases as meningitis, conjunctivitis, panophthalmitis, sinusitis, pneumonia, influenza, septicaemia, and endocarditis. Curtis reported one case in which micrococcus catarrhalis was found to be the cause of a bacteraemia with a subsequent polyarthritic involvement.

The morphological characteristics of the micrococcus catarrhalis and of the gonococcus are identical. The finding of a gram-negative intracellular diplococcus on a smear from the genital tract is usually considered sufficient evidence of a gonococcal infection, and, if a joint is also involved, presenting the typical signs and symptoms, the diagnosis is usually gonorrhoeal arthritis.

This similarity in the clinical picture and the difficulty of distinguishing the two organisms morphologically may lead to an error in diagnosis. To differentiate these organisms, cultural methods are necessary, particularly the fermentation of various sugars.

This possibility of an error in diagnosis and the apparent rarity of micrococcus catarrhalis arthritis warrant the report of the following case.

CASE REPORT

A. S., a white married woman, sixty-four years old, entered Cleveland City Hospital with symptoms of an acute arthritis of three weeks' duration. The left knee had become extremely painful and swollen and she had been forced to stop work. Subsequently the entire left leg had become swollen. No other joints were involved. One week previous to the onset of the arthritis she had noted a foul vaginal discharge, polyuria, and burning on urination.

The past history was not significant. The patient had eleven children, all living and well.

Physical examination on admission revealed an obese, obviously ill patient with a temperature of 40 degrees Centigrade and a pulse rate of 120. The fundi of both eyes showed marked nicking of the veins. The apex of the heart was in the fifth interspace, twelve centimeters from the mid-sternal line, and an aortic systolic murmur was heard. The peripheral vessels showed moderate sclerosis. Blood pressure was 230/124. The pelvic examination revealed a profuse, foul, yellow discharge. The red and lacerated cervix was not freely movable. The posterior lip bled easily when touched with an instrument. The position and size of the fundus were not determined, due to the patient's obesity. The left leg was swollen, with non-pitting oedema extending from the ankle to

well above the knee. The left knee itself was markedly swollen, tender, hot, and red. Motion was impossible, due to extreme pain.

Laboratory findings showed:

Red blood cells—4,100,000

Hemoglobin (Sahli)—93 per cent.

White blood cells—13,800

Differential (Schilling)

Segmented polymorphonuclear neutrophiles	68 per cent.
Stabs	16 per cent.
Juveniles	1 per cent.
Eosinophiles	2 per cent.
Lymphocytes	12 per cent.
Monocytes	1 per cent.

Sedimentation rate (modified Westegren)—115 millimeters in one hour; cell volume—34.5 per cent.

Wassermann test—negative.

Smear from the cervix—gram-negative intracellular diplococci.

Urinalysis—specific gravity, 1.044; a trace of albumin; sugar, four plus; acetone, positive; an occasional hyaline cast, and many white cells.

The provisional diagnoses were: acute gonorrhoeal cervicitis; acute infectious arthritis of gonorrhoeal origin, diabetes mellitus; arterial and arteriolar sclerosis with hypertension; and possible malignancy of the cervix.

Two days after admission, the left knee joint was aspirated and two cubic centimeters of purulent material was obtained. The purulent material was streaked out on several plates of Levinthal medium, to which ascitic fluid in the proportions of 4 to 1 had been added, and also on two plain agar plates. The Levinthal ascitic plates were placed in moist chambers and incubated at 37 degrees Centigrade. The agar plates were placed in an incubator at a temperature of 37 degrees Centigrade. After incubation of twenty-four hours, the Levinthal and agar plates showed abundant growth of colonies varying in size, grayish white, translucent and smooth, with a glistening surface, a slightly elevated center, and an irregular edge. The Levinthal plates were covered with a 1-per-cent. solution of tetra-methyl-p-phenylenediamine-hydrochloride.[2] The colonies did not develop the bright purple color characteristic of gonococci. Gram stains of colonies from both Levinthal and agar plates showed gram-negative diplococci in pairs and in clumps. Transplants from the original plates to sugar-fermentation tubes showed that after seventy-two hours the organisms did not ferment dextrose, lactose, maltose, or mannite. The laboratory diagnosis was micrococcus catarrhalis.

The joint was again aspirated eleven days later, when twenty cubic centimeters of purulent fluid was obtained, from which micrococcus catarrhalis was again obtained by culture. One month after admission the joint was aspirated, but the culture at this time was sterile.

A smear from the cervix was cultured and the report from the laboratory was: "Direct smear—Mixed flora with many gram-negative diplococci, of which only a few are intracellular." Micrococcus catarrhalis was isolated by the cultural method outlined above. This also changed the diagnosis to acute micrococcus catarrhalis cervicitis.

A roentgenogram taken four days after admission, or twenty-five days after onset of the symptoms, showed "narrowing of the medial portion of the joint with slight irregularity of the joint margins." A biopsy of the cervix was done one month after admission and the diagnosis was chronic endocervicitis. Diabetes mellitus was confirmed by the finding of a blood sugar of 220 milligrams per 100 cubic centimeters.

Therapy to the joint consisted of immobilization and local radiant heat. The diabetes was controlled with insulin and dietary measures. Forty days after admission the patient was up in a chair. The objective signs of inflammation of the joint had gradually subsided, although motion was limited and caused moderate pain. Subsequent physical

therapeutic measures in the form of local radiant heat, massage, and exercises restored the joint practically to normal function.

The final diagnoses were: arthritis and cervicitis due to micrococcus Catarrhalis; diabetes mellitus; and arterial and arteriolar sclerosis.

SUMMARY

In this case of arthritis, due to micrococcus catarrhalis, the clinical picture was that of gonorrhoeal arthritis. Organisms aspirated on two occasions from the joint and those found in a cervical smear were identical with the gonococcus morphologically, but cultural methods showed them to be micrococcus catarrhalis. Treatment resulted in complete restoration of function.

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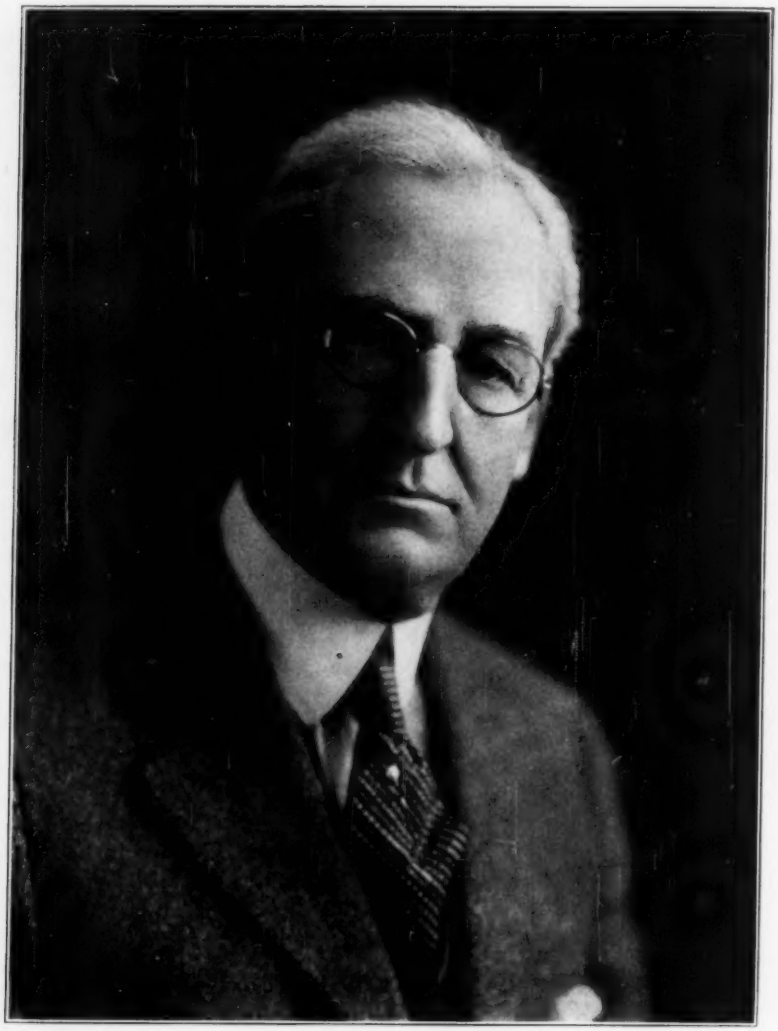

JOHN LINCOLN PORTER

JULY 2, 1864–AUGUST 11, 1938

Born in New England, among the hills of New Hampshire, Dr. John Lincoln Porter died in his adopted city of Chicago, in active service, after seventy-four years of a strenuous, successful, and productive life, loved by all his friends, esteemed by all who knew him, and respected by his associates for his sturdy character, so evident in all his dealings.

He began life with a purpose, and his subsequent career was a history of its accomplishment and the trueness of the aim to which he kept. In his determination to devote himself to the profession of medicine he never wavered, and he was never turned aside by obstacles which presented themselves or by difficulties which intruded along the way. Beginning with his efforts to obtain a medical education and continuing during the early period of establishing his professional position in his city, he showed a courage and a determination in regard to the uncertainty of the future which were evident throughout his life. He held the highest positions in the institutions of his community; he was an

active and an influential member of the local and national medical societies, and his counsel was sought in all of them.

His membership in the American Orthopaedic Association, with which he was associated in the early period of its existence, was distinguished by constant activity and interest. He was President in 1918, and he served as its Treasurer for twenty-six consecutive years, a position which he still held at the time of his death and which he had tried to relinquish, but his fellow members would not concur in this action. He managed the affairs of this Association with great judgment, and his influence in the conduct and establishment of its policies was not exceeded by any one of its members. His opinion was always a guiding force because of the confidence which he inspired in every member.

Dr. Porter enlisted early in the World War, and was Chief in his department in one of the important hospitals, where he organized and conducted an active and most efficient service. Particularly successful was the cooperation which he established with other groups in the same unit. He was able to contribute his skill and the results of his experience as an orthopaedic surgeon, and also as an administrator, to bring to the wounded under his supervision all the advantages of the different agencies which were then active, in order to obtain for these men the means which might restore them as nearly as possible to the normal. To this military service he gave all his time and energy during the war and in the post-war period, until relieved from active duty. He then slipped quietly back into his own individual work, leaving an enviable record.

The consummation of a successful life, which has been the fulfilment of an idea and the attainment of a purpose, is a legacy which serves as a guiding force and an inspiration to those who follow and to those who have need of a steadying influence in working out their own life problems. Perhaps during his early years he became imbued with the quiet strength of the New England hills, which by their steadfastness and sturdiness helped to mold the character, the basic traits of which he inherited from his parents. The courage, the strength of conviction, and the honesty of purpose were certainly there, and showed their influence in all his accomplishments. No greater tribute could be paid to anyone than the recognition of the success of a purposeful life and the gratitude of the host of those who have benefited by his kindly generosity throughout his career. His name will stand at the head of the list of those who have been preeminent in their love for their fellow men.

News Notes

The Seventh Annual Convention of the **American Academy of Orthopaedic Surgeons** will be held in Memphis, Tennessee, from January 15 to 19, 1939, under the Presidency of Dr. John C. Wilson. The full program for this meeting will appear in the January issue of *The Journal*.

The Annual Roll Call of The **American Red Cross** to enlist members for 1939 will be conducted throughout the nation from November 11 to 24, 1938.

Dr. Seth Selig and Dr. Robert K. Lippmann have been made Attending Surgeons on the Orthopaedic Service of Montefiore Hospital, New York City.

The next meeting of the **Orthopaedic Guild** will be held in Toronto, Canada, on November 25 and 26, 1938, under the Chairmanship of Dr. A. W. Farmer, 407 Medical Arts Building, Toronto.

The **Pan-Pacific Surgical Congress** will be held in Honolulu in September 1939. Any person desiring to present an orthopaedic paper before that Association should address the American Chairman for the Orthopaedic Section, Dr. Steele F. Stewart, 3780 Wilshire Boulevard, Los Angeles, California.

The Sixty-Seventh Annual Meeting of the **American Public Health Association** will be held in Kansas City, Missouri, October 25 to 28. More than 400 papers and reports will be presented and discussed and a special session will be devoted to a consideration of "Public Health Aspects of Medical Care". Further information may be obtained from the Association's headquarters, 50 West 50th Street, New York, N. Y.

The Fourth **World Conference of Workers for Cripples** is to be held in London, at Bedford College, from July 15 to 22, 1939, under the auspices of the Central Council for the Care of Cripples. Three subjects have been selected for discussion: (1) Preventive Orthopaedics in Childhood; (2) The Education, Vocational Training, and Subsequent Employment of the Crippled Child; (3) The Industrial Cripple. Discussion on the third topic will be opened by a member of the staff of the International Labour Office, which has an immense amount of material at its disposal relating to every country in the world. An interesting program of discussions and visits to institutions and other places of interest has been planned. Further information may be obtained from the Organising Secretary, 34 Eccleston Square, London, S. W. 1.

The Eighth Congress of the **Association Internationale de Thalassothérapie** was held from June 3 to 6, 1938, at Montpellier and Palavas, France. The Congress was opened by Rector Pariselle, who represented the Minister of National Education.

The subject of the scientific sessions was "Tuberculous Peritonitis", and a large number of interesting papers were presented and discussed by the members and guests. The results of heliotherapy in high altitudes and by the sea were compared and the relative values of operation and treatment by this therapy were discussed. The Congress was able to demonstrate the very great benefit obtained by this form of therapy, especially in preparing patients for operation.

During the four days of the Congress, the members were given the opportunity of visiting the hospitals of Montpellier and the sanatoria of Palavas and Grau-du-Roi, as well as places of historical interest in the vicinity.

The Annual Meeting of the **Société Française d'Orthopédie et de Traumatologie** will be held in Zurich and Lausanne on September 26, 27, and 28, 1938. On the first day, the members will visit the *Institut Balgrist* and the *Clinique "Hirslanden"* in Zurich, where cases will be presented and operations demonstrated by Prof. Scherb, Dr. Francillon, Dr. Burckhardt, Dr. Mülli, Prof. Dubois (Berne), Prof. Clairmont, Prof. Zollinger, Prof. Monnier, and Dr. Debrunner. The second day will be devoted to an automobile trip through Lucerne, Interlaken, and Montreux to Lausanne. On the third day, case presentations and demonstrations of operative technique will be given at the *Hôpital Cantonal de Lausanne* and the *Clinique Médicale du Hôpital Nestlé*, in which the following surgeons will take part: Prof. Nicod, Dr. Scholder, and Prof. Reinbold, of Lausanne; and Dr. Martin-du Pan, Prof. Jentzner, Dr. Fauconnet, Dr. Brocher, Dr. Oltramare, and Dr. Perrot, of Geneva. The final day will be left open, so that the members may have an opportunity to visit the places in which they are most interested.

The Annual Meeting of the **British Orthopaedic Association** will be held in Birmingham on October 21 and 22, 1938.

At a recent meeting of the Executive Committee, the following orthopaedic surgeons were elected to Associate Membership in the Association:

Mr. L. O. Betts, 196 North Terrace, Adelaide, South Australia.
Mr. James P. Campbell, Harlow Wood Orthopaedic Hospital, near Mansfield, Nottinghamshire.
Mr. F. P. Fitzgerald, Royal National Orthopaedic Hospital, 234 Great Portland Street, London, W. 1.
Mr. D. W. Griffiths, Manchester Royal Infirmary, Manchester, 13.
Mr. H. E. Griffiths, 90 Harley Street, London, W. 1.
Mr. G. T. Partridge, Charing Cross Hospital, London, W. C. 2.
Mr. F. G. S. C. Strange, St. James Hospital, Ouseley Road, Balham, London, S. E.
Mr. R. G. Taylor, Royal Infirmary, Sheffield.

The following surgeon has been made a Full Member of the Association:
Mr. E. B. M. Vance, 159 Macquarie Street, Sydney, New South Wales.

The Third Congress of the **Sociedade Brasileira de Ortopedia e Traumatologia** took place on July 1, 2, and 3, 1938, in Recife, Brazil, under the presidency of Prof. Barros Lima.

The principal subjects, which were chosen for discussion at the last Congress, were: "Fractures of the Ankle" and "Sequelae of Infantile Paralysis". Two papers on these subjects were presented by Dr. Orlando Pinto de Souza and Dr. Godoy Moreira.

Prof. Mario Ramos presented an excellent study on "The Bacteriological Diagnosis of Osteo-Articular Tuberculosis by the Culture of Koch's Bacillus. Prof. Define spoke on "Pre-Luxation of the Hip" and presented personal cases. Prof. Barros Lima gave an interesting study on "Subtrochanteric Osteotomies" with indications for their employment.

At the business session on July 3, the following officers were elected:
President: Prof. Barros Lima
Vice-President: Dr. Godoy Moreira
General Secretary: Dr. Renato Bomfim
Assistant Secretaries: Dr. Itapema Alves and Dr. Alcino Coimbra
Treasurer: Dr. Domingos Rezende
Librarian: Dr. Ulysses Barbuda.
Prof. Rezende Puech was chosen Honorary President of the Society.

The next Congress will take place in São Paulo, in July 1940, under the presidency of Prof. Define. The following subjects have been chosen for discussion: "Fractures of the Spine" and "Lumbar Pain".

The Thirty-Third Congress of the **Deutsche Orthopädische Gesellschaft** will be held in Giessen on October 3, 4, and 5, 1938, under the Chairmanship of Prof. Peter Pitzen. The subjects for discussion are as follows: Orthopaedic Surgery and Working People; Orthopaedic Technique; Orthopaedic Surgery and Gynecology; Primary Bone Tumors; Vitamins and Hormones. There will also be several papers on various other orthopaedic subjects presented by members and guests.

At the **Réunion d'Orthopédie et de Chirurgie de l'Appareil Moteur de Bordeaux,** held on June 30, 1938, the following papers were presented:

Myeloma of the Humerus—Dr. R. Dieulafé.

Fracture of the Epitrochlea; Inclusion of a Fragment in the Articulation of the Elbow—Dr. M. Touya.

Nailing of the Neck of the Femur; Description of an Apparatus to Aid in this Procedure—Dr. M. Touya.

A Case of Fracture of the Acetabulum with Intrapelvic Luxation of the Femoral Head—Dr. J. Magendie.

Congenital Articular Rigidity of the Limbs in a Boy of Twelve Years—Prof. P. Nicod.

Two Cases of Epiphysitis of the Second Metatarsal—Dr. R. Guérin and Dr. R. Fourcade.

Radial Club Hand—Dr. H.-L. Rocher.

Apparatus for Congenital Luxation of the Hip—Dr. Charles Lasserre.

Continued Traction by the Kirschner Wire—Dr. Charles Lasserre.

Diagnosis of Chronic Synovitis in the Adolescent and in the Adult—Dr. Charles Lasserre.

Old Malunited Fracture of the Elbow, with Total Disability; Result of Reparatory Treatment—Dr. R. Charry and Dr. G. Charry.

Dystrophy of the Lower End of the Femur in a Child of Three Years—Dr. Edouard Papin.

Indications for Tarsectomy in Osteo-Arthritis of the Anterior Tarsus—Dr. Andrieu.

The Annual Congress of the **Czechoslovakian Orthopaedic Society** was held in Prague on July 8 and 9, 1938, under the presidency of Prof. Dr. Zahradníček.

The program consisted of two principal papers,—"Pseudarthrosis", by Prof. Zahradníček; and "Aseptic Necrosis of Bone," by Prof. Frejka.

In speaking on the subject of pseudarthrosis, Prof. Zahradníček stressed the consideration of the development of the callus, the importance of the hematoma in the wound, and the metaplasis of the callus, the normal growth of which is influenced by static-dynamic forces. He mentioned the conditions which have an unfavorable influence on osseous union,—poor reposition, insufficient fixation of the fragments, eburnation of the extremities of the bones, interposition of the muscle, and infection. He advocates long-continued fixation in a well-applied plaster bandage, and believes that age does not particularly influence pseudarthrosis. He also stressed the importance of proper nourishment, the influence of vitamins, sympathectomy, and the drilling of the bone. In surgical treatment it is necessary to eliminate as much of the scar tissue as possible, to make complete correction of the deformities, and to open widely the medullary cavity. He advised against the use of any internal fixation such as a medullary graft, and recommended the transplanation of bone in the more extensive defects.

The subject was discussed by Dr. Havránek, Prof. Burian, Dr. Grospić, Dr. Pavlík, Dr. Vavrda, and Dr. Stepán, who added the results of their experience in the treatment of this rather intractable condition.

In his paper on aseptic necrosis of bone, Prof. Frejka stated that this condition is now interesting the medical profession and is receiving a great deal of attention. It is known that necrosis often arises from inflammatory conditions, from tuberculosis, from lues, from chemical irritations, and from treatment by the roentgen ray and radium.

Clinically, the most important type is the traumatic necrosis which either is the result of direct injury, such as fractures of the bones, contusions of the superficial membranes of the joints, and osteochondritis dissecans, or is secondary to fractures of the neck of the femur, to trauma to the spine (Kümmell-Verneuil disease), or to certain operations (transplantations, reductions of congenital dislocations, and operations on the head of the femur). He also discussed the relation of aseptic necrosis to spontaneous necrosis of the femoral head in Legg-Calvé-Perthes disease and to necrosis of the scaphoid. He suggested the advisability of designating all these conditions by anatomical names and eliminating all those terms which do not indicate the anatomical changes.

Dr. Jaroš called attention to the importance of fractures and necrosis of the lunate from the point of view of insurance.

Papers were also presented by Dr. Hanák, Dr. Grospić, Dr. Delić, Dr. Jaroš, Dr. Hanausek, Dr. Pavlík, Dr. Jeřábek, and Dr. Pavlnský on the following subjects: surgical treatment of scoliosis, arthrodesis of the hip, different forms of fixation of the hip by graft, the relation of malposition of the lower part of the pelvis to torticollis and congenital luxation, measurement of joint mobility, the results of experiments in the transfusion of white blood corpuscles, the stimulation of bone growth by mechanical irritation, such as the driving in of a nail, etc., the result of removing the upper anterior edge of the acetabulum in the Smith-Petersen operation, and the differential diagnosis of vertebra plana.

Prof. Zahradníček was re-elected President. The next Congress will take place at Prague in the spring of 1939.

EDVILLE G. ABBOTT

NOVEMBER 6, 1870–AUGUST 27, 1938

Dr. Edville G. Abbott died suddenly on August 27, 1938, at the age of sixty-eight, at his home in Portland, Maine.

Dr. Abbott came from a race of seafaring people and inherited much of their sturdy character. After his preliminary studies, he entered Bowdoin Medical School, from which he was graduated in 1898. He continued his studies in this country and abroad, and established himself in practice in Portland in 1901. Dr. Abbott was a strong influence in the establishment of orthopaedic surgery in his state and particularly in Portland. He was a pioneer in his specialty in his chosen city, and his life is a record of many accomplishments as the result of his industry, skill, and forceful character. Dr. Abbott held important positions in the principal institutions in Portland, as well as being a consultant in many other hospitals in his city and state; he was the first Surgical Chief in the Children's Hospital, in the establishment of which he was largely influential, and was Chief Orthopaedic Surgeon in the Maine General Hospital. He had received honorary degrees from several colleges.

Dr. Abbott took an interest in the treatment of scoliosis at a period when this important condition was attracting but little attention, mainly because of the discouraging results, and he became internationally prominent through the original and forceful method of treatment which he advocated. He was responsible for the stimulation of an active interest in the treatment of this affection in the orthopaedic world, both in the United States and abroad, and this continued active interest has been productive of a very decided advancement in the understanding and treatment of this affection.

SCOLIOSIS IN YOUNG INFANTS

NOTE: In view of the current marked interest in the subject of scoliosis, Dr. Charles W. Goff, of Hartford, Connecticut, has prepared the following abstract of a number of articles written by Dr. R. J. Harrenstein, of Amsterdam, for the *Zeitschrift für orthopädische Chirurgie* and *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*. Dr. Goff has also had the opportunity of observing Dr. Harrenstein's work at the *Emma-Kinderkrankenhaus* in Amsterdam.—*Editor*.

In a comprehensive study of scoliosis in very young infants, Dr. Harrenstein points out that the early discovery of this deformity rests with the paediatrician, and emphasizes the importance of more careful observation in order that no case may be overlooked.

Believing that many children show an asymmetry of the thorax very early, he proceeds to demonstrate the rate of growth and shape of the rib cage by means of cross-sections and through the use of roentgenographic studies of rib epiphyses. At birth, and until from five to nine months of age, the thorax is relatively square, with the corners of the square slightly rounded. At one year of age, the anterior portion of the thorax begins to show less rapid growth, with a greater curving of the posterior angles, so that at six years of age the thorax is egg-shaped. Any interference with growth in one or more rib epiphyses will produce inequality, and generally a gibbosity develops. This predisposes to scoliosis, and eventually a total or a mixed type of scoliosis may follow. Actual measurements of ribs from dried specimens are presented, which show an early scoliosis with a gibbosity to prove his theory of growth inequality. Dr. Harrenstein believes that a rachitic background accounts for but a very small number of the cases in his series.

Two cases are reported in which a gibbosity occurred with a kyphosis and not as the result of scoliosis. Both patients had developmental changes in the bodies of at least one vertebra, which allowed the trunk to slump forward. The mechanical failure is identical with Pott's disease.

The corrective form of treatment employed by Dr. Harrenstein in cases of infantile scoliosis consists of the application of a plaster posterior shell or "*Gipsbett*", the anterior portion of which is open; straps alone hold the infant within the bed. To apply this shell, the infant is placed with his face upon a board punched with holes. The correction is obtained by lateral bending and is maintained by inserting rods into holes nearest to the position of correction. "The head, which rests on a cushion, must be held so that the mouth and nose are completely free. Both arms are fastened to the edge of the table with bands. After that a few rods are placed in the board along the patient's pelvis and as high as the axillae, directly against the trunk. The length of the rods is such that they do not extend above the trunk. To give the cast a corrective shape, one may, with the help of hand pressure (toward the right, for example), displace the spinal column, which is convex toward the left, and keep the position thus obtained by placing a few rods along the left side of the trunk. Before making the plaster bed, it is also necessary, depending upon the site of the costal projection or gibbosity, to put a cushion of wadding or felt against the flattened part of the back. In this way a hollow in the plaster is obtained, giving the space necessary for restoring the normal shape.

"One must also place a cushion over the place where the gibbosity is situated. When the curvatures are multiple, the corrective action should be exercised by means of several cushions.

"The costal gibbosity generally disappears rather quickly. If, after a few months of this treatment, it is ascertained by roentgenographic examination that the spinal column is straightened and that the costal projection has disappeared, the time of dorsal recumbency in the plaster is diminished, while the period of ventral recumbency is consequently prolonged. It is not until much later that the patient may sit up or

stand up, upon condition that he undergo a regular check-up for a long time (one to two years)."

In 1933 only nine cases were observed sufficiently long to draw any conclusions. In a tenth case that was untreated, spontaneous recovery took place after a period of four years. This somewhat confounded Dr. Harrenstein.

In 1936, thirty-seven cases were reported with the following results:

End Result	*No. of Cases*
Cured	11
Not cured	11
Still being treated	10
Dead	1
Impossible to judge	4

The duration of check-up in the cured cases ranged from one year to six years after the end of treatment.

A study of the check-up examinations of the nine children affected with multiple deviations at the beginning of the treatment showed the following results: cured, one case (check-up after four years); improved, three cases; aggravated, three cases; still being treated, two cases.

"After a follow-up examination, four years later, of patients whom we were able to locate, we ascertained that, of four patients considered as cured in 1928, three remained completely normal. This short summary of the experience of the author with this treatment shows that, even with these young children, only a certain percentage may be considered as cured. Some errors committed in the treatment have provoked the formation of compensating curvatures in the lumbar region, and some permanently exaggerated corrections have also arisen. Furthermore, the results have often been incomplete, due to insufficient cooperation of the parents, who either did not apply the treatment prescribed or did not apply it long enough."

Antirachitic prescriptions are indicated as a rule, although about four-fifths of the cases reported were thought not to be of rachitic origin. According to Dr. Harrenstein, the growth differential is almost always the underlying cause. He makes no mention of posture *in utero* as even a possibility in his causal relations. No compensatory curve should be developed; the corrective treatment should be terminated when roentgenographic studies show that the spine has returned to the position of a straight line. The child must never be allowed to sit or to stand. For twenty hours a day the patient is kept in the plaster bed, and for four hours he is kept on his face in a simple canvas corset, during which time he can exercise more fully. The plaster should not be changed until the child has outgrown or destroyed the bed. The Jansen plaster bed cannot be used for small children.

RÉSUMÉ

"We see more frequently in infants and in children of lower age groups fixed lateral curvature of the vertebral column than congenital scoliosis caused by anomalies of the skeleton. These lateral curvatures do not show on roentgenographic examination any anomaly of development. The symptoms are not observed at birth and do not develop for several months. The formation of the curvature is not appreciably influenced by the fact that the mother carries the infant on her arm.

"It has been shown that rachitism is not a causal factor in most instances. It has been demonstrated that this early scoliosis can be cured in 50 per cent. of the cases by the institution of careful treatment. The fact that slight cases have improved without treatment should not permit us to wait before attempting correction. The risk of aggravation is enhanced by waiting. Fixed curvatures should be considered the beginning of a scoliosis which may not be recognized until considerably later. Orthopaedic supervision should be recommended early in the infant's life, so that recognition of these disturbances can be appreciated."

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Personal letter, May 1938.

Correction

Dr. Sterling Bunnell of San Francisco has requested that we call attention to a correction in his article entitled "Opposition of the Thumb", published in *The Journal* for April 1938. Line three on page 281 should read: "In regard to tendons, the *flexor pollicis brevis* is excellent as it"; and line thirty-one on page 282 should read: "Another method is to detach the tendon of the *flexor pollicis brevis*".

Current Literature

EXPERIENCE IN THE MANAGEMENT OF FRACTURES AND DISLOCATIONS (BASED ON AN ANALYSIS OF 4390 CASES). The Staff of the Fracture Service, Massachusetts General Hospital, Boston. Under the General Editorship of Philip D. Wilson, M.D. Philadelphia, J. B. Lippincott Company, 1938. $15.00.

This treatise on the subject of fractures and dislocations is unusual in that it is based upon the study of actual cases and the analysis of the results of treatment. The material is from the Fracture Service of the Massachusetts General Hospital, which has a staff composed of skilled and experienced general and orthopaedic surgeons, who have devoted a large portion of their time to the conduct of this Service, and who have met together at frequent intervals to discuss and to decide upon not only the general treatment but also the management of special cases under their care. This Staff has also spent considerable time in following up the patients and in determining the end results. They have thus been able to check up on the relative efficiency of the different methods of treatment and to evaluate the results from the point of view of anatomical restoration, functional recovery, and working power. This book, then, represents the individual and collective experience of this group. It is edited by Dr. Philip Wilson of New York City, formerly a member of this Staff, with the members of this Service during the period 1923–1930 as collaborators.

The book is too comprehensive to discuss each subject in detail, but it is hoped that this collection of actual cases and their end results will be of practical assistance to physicians seeking the most effective treatment for similar cases.

This volume contains 1036 pages and 1419 illustrations and represents the observation of 3985 patients and 4390 fractures. Of this group, 1573 patients and 1937 fractures were treated in the wards of the Hospital, and 1192 of these patients (1511 injuries) were examined a year or more after injury. Each collaborator was assigned an anatomical region or type of fracture. The text is full, and the illustrations are numerous. Most of the illustrations are schematic diagrams or tracings of roentgenograms, which is a graphic and practical method of showing the type of fracture and the position of the fragments, and often demonstrates the distortion more clearly than the roentgenogram itself. The details of the technique of many of the operations are given, which should be appreciated, coming as it does from men of such experience, for this information is often lacking in editions of this kind. The reader has the advantage of being able to compare a large number of case notes with the text, thus permitting him to form an opinion of his own.

So many textbooks on this subject, as well as on other subjects, deal with the abstract types of injury, and the discussions of diagnosis and treatment are concerned with the application of general principles. Since this work gives the results of experience with actual cases, including the case histories and the discussion of the treatment, it makes available a large amount of unusually pertinent information for all who are dealing with these injuries.

THE RHEUMATIC DISEASES. A COURSE OF LECTURES ARRANGED BY THE MEDICAL STAFF OF THE ST. JOHN CLINIC AND INSTITUTE OF PHYSICAL MEDICINE. Edited by Sir Leonard Hill, M.B., LL.D., F.R.S., and Philip Ellman, M.D., M.R.C.P. With a Foreword by Sir Arthur MacNalty, K.C.B., M.D., F.R.C.P. Baltimore, William Wood & Co., 1938. $4.00.

This series of twenty post-graduate lectures, delivered at the St. John Clinic, should be read carefully by those interested in the rheumatic diseases: first, because of, rather than despite, the marked divergence of opinion expressed, and second, for the reason that

they make evident the great value of cooperation and teamwork in the study and treatment of a vital problem.

There are obvious shortcomings—such as variable classifications in the different lectures, strongly personal and theoretical viewpoints with lack of factual backing, and unmerited emphasis on some subject matter—but withal there is an obvious sincerity of purpose.

The etiological and clinical survey of Wilcox conforms to the classic researches of Poynton and Payne, which are the basic principles of the infective theory. The importance of the nasopharynx and intestinal tract as persistent foci of infection is justifiably stressed.

Fox's review of the social and economic aspects is effectively written and should be a spur to further concerted effort in the United States, where we have small right to be satisfied with our progress to date.

Classification, discussed by Ellman, is a moot subject as always, but one cannot help being in sympathy with his attempt at simplification. His chapter on drugs is fairly comprehensive, but seems to be overweighted with gold.

Findlay, at variance with some of the others, finds little to confirm the belief that acute rheumatic fever of childhood is allied to chronic rheumatic afflictions of later life. His discussion of the "mischief" is interestingly agnostic.

The lecture on pathology by Fisher is well illustrated and effective, even though he disregards bacterial invasion out of preference to the virus theory, which has so little to recommend it. His final chapter on orthopaedic cooperation is excellent and important.

Barwell rightly indicts the nose and throat and briefly defends the proper use of diathermy.

Oldershaw and Robinson convincingly present the pelvis as the most frequently overlooked focus of infection. The latter author also summarizes the signs and treatment of sciatica and brachial neuritis.

In his lecture on radiology, Calthorp seems to suggest the desirability of reading Gilbert Scott.

The influence of low-grade infection in the non-articular rheumatic afflictions is well outlined by Bach, and he also gives a fair appraisal of the value of hydrotherapy.

Gordon clearly differentiates between ankylosing arthritis of the spine, with its gloomy prognosis, and the more benign osteo-arthritic type. His chapter on fibrositis is an excellent presentation of a most frequently unrecognized condition.

Koerner and Poulton lay what many will consider undue stress on antistreptolysins, but they note a point well worth stressing,—namely, the probability that gout may have an infective background.

Taylor's physical basis of physical medicine is a lucid though somewhat technical presentation that should serve to clarify the rationale to many of us.

The chapter on physiological action by Hill is short and in part theoretical, but is an excellent summation of the subject.

Eidinow presents the indications for light therapy and the technique of treatment with ultra-violet rays in two separate lectures. Despite his obvious enthusiasm, he has presented his material with such fairness and clarity that its careful consideration should make the average worker in this field more effective.

KOLLATERALE ENTZÜNDUNGSZUSTÄNDE (SOG. AKUTE KNOCHENATROPHIE UND DYSTROPHIE DER GLIEDMASSEN) IN DER UNFALLHEILKUNDE [Collateral Inflammatory Conditions (So-Called Acute Bone Atrophy and Dystrophy of the Extremities) in Traumatic Surgery]. Dr. Paul Sudeck. (Beihefte zur *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, Heft 24.) Berlin, Julius Springer, 1938. 6.40 marks.

This monograph is written in further pursuit of the concepts advanced by Rieder and Sudeck that acute bone atrophy represents an inflammatory reaction of repair and

reconstruction, directed towards the formation of physiological bone structure, that it occurs in response to injury, and that it is applicable also to muscle and other tissues even at a distance from the site of injury. The rôle played by inactivity is discounted. If the injury is too severe or prolonged, regeneration is retarded, calcification is hindered, and the condition becomes a dystrophy; when the process of dystrophy becomes stationary, atrophy occurs. Sudeck summarizes his theory as follows: "We may therefore distinguish three fundamentally different stages, which for some time have been combined under the concept of acute (Sudeck's) bone atrophy: (1) inflammation (regarded as productive repair reaction); (2) dystrophy (chronic degenerative inflammation); and (3) atrophy (subsided inflammation)."

An attempt is made to allot symptoms and signs to these stages, as well as to subdivide the stage of dystrophy, but even Sudeck has difficulty in constructing categories and drawing distinctions among these stages. The factor of trauma and its repair is made too inclusive, and, in addition to overlooking other possible causes for late tissue changes and atrophy, leads to an open disregard for the element of inactivity, even though the latter is often undeniably implicated by the very evidence which is adduced to disprove it. The particulars which are sought to confirm the general proposition are often indefinite and contradictory.

The monograph includes eighteen clinical examples of the later course of injuries to the extremities. They are advanced as illustrative of the stages of inflammation, dystrophy, and atrophy, but are marred by this effort, as they do not necessarily provide evidence for Sudeck's theory. However, the monograph is of definite value in calling attention to the changes that may occur following injury to an extremity. The author has made many careful observations, which are useful guides to prognosis and to the sound lines of treatment which he recommends.

THE AMERICAN ILLUSTRATED MEDICAL DICTIONARY. W. A. Newman Dorland, A.M., M.D., F.A.C.S, with the collaboration of E. C. L. Miller, M.D. Ed. 18. Philadelphia and London, W. B. Saunders Company, 1938. Plain, $7.00; Thumb Indexed, $7.50.

During the past few years, the rapid developments in medicine, particularly in the field of research, and the elaboration of new methods and means of diagnosis, have brought about many changes in and additions to the medical nomenclature. The revision of some of the systems and the adoption of a more descriptive terminology, as, for instance, in the field of Anatomy, have also resulted in many changes. The medical public should be appreciative of the fact that the publishers of this book have recognized these changes at so early a date and have made available so quickly this revised edition.

The previous edition has been enlarged by over sixty pages and completely revised. The thoroughness of this revision can be realized from the fact that 3,000 new words have been defined, hundreds of which are not to be found in any other dictionary. As indicated in the Preface, the largest number of important additions and changes are in the fields of Endocrinology, Immunology, Pathology, Medical Chemistry, Clinical Medicine, Dentistry, and Biopsychology.

As those who are familiar with the previous editions know, in addition to the concise definitions of recognized medical terms, in many cases further clarified by illustrations, the book contains a wealth of descriptive material, as well as anatomical and clinical tables, chemical formulae, tests, methods of treatment, etc. The 283 portraits of distinguished medical and surgical men will be found an interesting addition to the purely technical data. The pronunciation, capitalization, and preferred spelling of each term are clearly indicated and the derivation given. The material is admirably arranged, affording quick and easy access to the reader.

At a time when so much is being added to the general medical knowledge and so many new terms are necessary to describe and discuss the medical problems of today, there is great need of a uniform nomenclature which would facilitate the exchange of ideas and encourage cooperation among the members of the medical profession, and to

this end the Eighteenth Edition of the American Illustrated Medical Dictionary will aid to an extent greater perhaps than any other one influence.

INNERE MEDIZIN IN DER CHIRURGIE. Doz. Dr. med. habil. H. Frh. v. Kress und Dr. med. W. Kittler. (Neue Deutsche Chirurgie, Bd. LIX.) Stuttgart, Ferdinand Enke, 1938. 11.80 marks.

The best reference book on medicine for the surgeon is obviously the standard medical textbook. To simplify medicine for the surgeon, or to present medical facts to him in a different way, would be to patronize his medical knowledge. However, there are certain fields of abnormal physiology which are peculiarly important to the surgeon, and which are justifiably discussed for his benefit. The present small volume does just this and serves as a supplement to the surgical textbook.

The interest of the authors is indicated by the fact that, of the 141 pages, 116 are devoted to pulmonary and circulatory disturbances. Particular attention is given to preoperative and postoperative conditions of the circulation, their diagnosis, prevention, and treatment. The differential diagnosis between collapse or shock and cardiac failure is discussed thoroughly from a modern viewpoint. The numerous conditions which may contribute to circulatory failure are considered separately and thoroughly. The treatment of collapse during anaesthesia, immediately postoperatively, and during the days subsequent to operation, is quite fully described.

Valuable and new to the average American physician is the discussion of the use of strophanthin in cardiac patients. The authors regard strophanthin as the most valuable remedy of the digitalis group. It is recommended in doses of 0.25 to 0.5 milligrams given intravenously daily, preferably in concentrated glucose solution, for the preoperative care of the cardiac patient. Not mentioned is the apparent contra-indication of strophanthin in the presence of digitalization and during the administration of calcium.

The short sections on hyperthyroidism are not of especial value to American physicians. That there is danger of producing or increasing hyperthyroidism by the use of iodine is not the experience of most observers in this country.

The care of the pneumonia patient is quite incompletely described, inasmuch as the use of serum and other valuable remedies, which have been elaborated in America in recent years, is omitted.

The preparation of the diabetic patient is simply and adequately told. The use of protamine insulin is not included. There is a short section on the treatment of patients with obstructive jaundice and its complications. The book closes with an excellent section on the treatment of disorders of sleep.

The book is written and arranged in readable fashion and can be strongly recommended for study.

OUTLINE OF ROENTGEN DIAGNOSIS. AN ORIENTATION IN THE BASIC PRINCIPLES OF DIAGNOSIS BY THE ROENTGEN METHOD. Leo G. Rigler, B.S., M.B., M.D. Atlas Edition. Philadelphia, J. B. Lippincott Company, 1938. $6.50.

This book is the outcome of the author's collection of material and the development of his method in preparation for teaching undergraduates. Repeated requests for a more complete exposition of his ideas and his material have resulted in this present publication.

The first section of the book consists of text only, in which the author considers the various affections according to the regional division of the body, and gives a brief description of the conditions and the roentgenographic findings, with their significance and interpretation.

The second part of the book is composed of illustrations, grouped in atlas fashion, to show the various affections which are taken up in the text of the first portion. These illustrations consist of roentgenograms, teaching drawings, and schematic diagrams. Since they have been used for teaching, they have been carefully selected, and their value has been proved. Each has a very complete legend, so that this portion of the book may be studied independently of the other.

A Student Edition without the atlas is also published, but the illustrations form a very important part of this work.

The book is comprehensive in its scope, including as it does the study of practically the entire body, and treating both the medical and surgical conditions. A generous portion is given to the consideration of orthopaedic and traumatic problems, the different stages in the course of bone diseases, and the types of fractures.

Since roentgenology is an adjunct to almost every field of medicine, this book will be useful to every physician and surgeon.

DIE KNOCHENGESCHWÜLSTE (Bone Tumors). Dr. med. habil. Hans Hellner. Berlin, Julius Springer, 1938. 49.80 marks.

This book is one of the best and clearest clinical expositions of the subject that has been written. It describes bone tumors from the standpoint of diagnosis and treatment. The classification of tumors adheres to that of the Registry of Bone Sarcoma of the American College of Surgeons and agrees with the histogenetic classification described in greater detail by Geschickter and Copeland. Hellner's book not only presents the most recent views on bone-tumor pathology, but shows that the modern classification of bone tumors is the most useful in determining the nature and treatment of neoplasms appearing in bone.

The book is profusely illustrated by photomicrographs and roentgenograms. Although the histological illustrations lack detail, the roentgenographic reproductions are good and many authors would do well to follow the excellent example of incorporating brief case histories in the legends to the illustrations.

Hellner covers all neoplasms affecting bone. There is a particularly good consideration of intracranial tumors, producing bone changes which are visible roentgenographically, as well as of maxillary tumors of dentigerous origin. Three much-discussed topics are relieved of their frequent ambiguity, and the author succeeds in reconciling prevailing and conflicting views on bone changes associated with hyperparathyroidism, giant-cell tumors, and Ewing's sarcoma.

"*Die Knochengeschwülste*" is the result of ten years' study of the bone-tumor material of Coenen's University Surgical Clinic of Münster, and is supported by a tremendous bibliography from which Hellner has derived and balanced the best opinions. The book leaves much unsaid, but all to the advantage of clarity and brevity. The translation of Hellner's book would greatly further the general understanding of a subject which heretofore has remained too closely within the confines of special study.

DER MENISKUSSCHADEN ALS KLINISCHES, ANATOMISCH-PATHOLOGISCHES UND UNFALLMEDIZINISCHES PROBLEM (Lesions of the Meniscus from the Point of View of the Clinical Aspects, Pathological Anatomy, and Traumatic Surgery). Dr. Hans Schaer. Leipzig, Georg Thieme, 1938. 11.80 marks.

In spite of the voluminous existing literature on lesions of the meniscus, this 150-page monograph with fifty-five illustrations is somewhat different in its points of attack under the following three distinct headings: The Clinical Aspects, The Pathological Anatomy, and The Significance in Traumatic Surgery. The clinical consideration occupies more than half of the volume. It is concise, but complete and unbiased enough to be accepted as a text for students of any country. The mechanism of causation and types of injury are clearly shown. Modern are the uses of arthrography in the diagnosis and of elastic adhesive as a dressing. The details of the local operative technique and after-care, with a discussion of results, are presented.

The pathology—in particular, the histopathology—is well illustrated in color. Degenerative changes are significant, and are discussed again in the third chapter which considers the compensation angle. The relationship between lesions of the meniscus and degenerative arthronosos is well established. A comprehensive bibliography is appended.

THE SYNOVIAL MEMBRANE AND THE SYNOVIAL FLUID WITH SPECIAL REFERENCE TO ARTHRITIS AND INJURIES OF THE JOINTS. David H. Kling, M.D. Los Angeles, Medical Press, 1938. $5.00.

The physiology of the production and absorption of joint fluid in health and in disease and the characteristics of the fluid found in various pathological conditions are subjects which are being investigated intensively by various workers. Kling, in this interesting monograph, records the present state of our knowledge. Of definite value for the orthopaedic surgeon is the outline presented in Chapter XXII on "The Diagnostic Value of a Systematic Examination of Joint Effusions".

The literature has been carefully reviewed, and the findings of practically every investigation are recorded, but the author has made only a feeble attempt to assimilate and to systematize this complex mass of basic data.

DIE WERKSTOFFE IN DER ORTHOPÄDIE: IHRE EIGENSCHAFTEN, VERWENDUNG, UND PRÜFUNG (Materials in Orthopaedic Surgery: their Qualities, Application, and Examination). Dr. Hans Priess. Leipzig, Georg Thieme, 1938. 10.80 marks.

This book contains a wealth of technical description compiled by the head of the German government bureau in charge of the examination of materials required for the medical maintenance of war veterans. It describes and examines fundamental materials used in orthopaedic surgery—wood, leather, steel, light metals, cellulose derivatives, rubber compounds, cloth, felt, sewing materials, plaster, glass, porcelain, etc.—and a final chapter deals with the deleterious effect of body perspiration on many of these substances. Each material is introduced by establishing its place in government regulations and commerce, and it is then followed from natural or chemical origins through the processes of fabrication and modification to its ultimate orthopaedic uses. Each chapter is concluded by a description of the rigid analysis and testing to which the materials are subjected, and standards are derived from these examinations.

Priess's book is a compendium of technical detail, which provides the soundest standards for the materials used in orthopaedic practice. One might be inclined to dismiss it as a technical reference book, but Priess infuses it with remarkable life and readability. In his complete correlation of materials, with their ultimate application, he achieves a volume in which orthopaedic surgeons need not hesitate to seek answers to the many questions that it so completely discusses.

ON THE INJURIES TO THE LIGAMENTS OF THE KNEE JOINT. A CLINICAL STUDY. Ivar Palmer. (Acta Chirurgica Scandinavica, LXXXI, Supplementum LIII.) Stockholm, 1938.

From the ski runs of Stockholm came most of the fifty-eight cases which furnish the basis of this 275-page monograph. The anatomy is thoroughly reviewed and embellished by original illustrations. Clinical and cadaver studies serve to clarify the mechanism of various injuries. A plea is made for accurate diagnosis of recent injuries at a time when repair can be efficient. The methods of diagnosis and treatment of both acute and chronic lesions are clearly presented, with excellent drawings by the writer. Arthrography with a contrast medium furnishes roentgenograms of surprising clarity, which, for the most part, are well reproduced. Recent tears of the cruciate ligaments are usually repaired by suturing with black silk drawn through drill holes. Ruptured collateral ligaments occasionally require operation, as illustrated by several cases. The repair of chronic injuries is a large undertaking, and complete restitution cannot be expected. Only those knees with considerable disability should be operated upon according to the suggested methods.

No effort has been spared in preparing the material, which is well organized and most readable.

AKUTE GLIEDMASSENDYSTROPHIE IN IHRER BEDEUTUNG FÜR DIE BEHANDLUNGSMASSNAHMEN IN DER UNFALLCHIRURGIE (Acute Trophic Disturbances of the Extremities from the Point of View of Treatment in Traumatic Surgery). B. Karitzky. (Beihefte zur *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*. Heft 22.) Berlin, Julius Springer, 1938. 4.40 marks.

In this fifty-two page monograph, Karitsky presents a study of acute trophic disturbances of the extremities from the point of view of treatment in traumatic surgery. The work is based on observations and procedures in the *Chirurgische Universitätsklinik*, Freiburg in Breisgau.

The trophic manifestations are attributed to irritative phenomena associated with the shock of trauma, to the presence of infection, and to neurotic and thrombotic effects. Careful attention by the surgeon to each structure involved is necessary to avoid the dystrophy. Above all, the author stresses the fact that early anatomical restoration is a prerequisite of functional restoration. He also criticizes the manhandling of tissues by unnecessary postoperative manipulations. He makes the interesting observation that the dystrophic tissues are unsuited for transplantation because of their impaired vitality. Since the volume is essentially a detailed report of procedure, it is necessary to read the entire contents to obtain a complete understanding of the technique used in wound handling in the Freiburg Clinic.

RÉSULTATS ÉLOIGNÉ DU TRAITEMENT DES FRACTURES DE LA ROTULE PAR LE CERCLAGE (Late Results of Patellar Fractures Treated by Cerclage). Monroe Bertram Gall. Thèse de Strasbourg, 1938.

In a small monograph prepared for the Doctorate at the University of Strasbourg, the author briefly reviews the methods more commonly employed for the treatment of patellar fractures. At the Surgical Clinic B, the method of cerclage, with bronze aluminum wire, is used in all types of transverse fractures in which there is displacement of the fragments. Following the insertion of the wire, the leg is immobilized in extension for a period of six weeks. The wire is removed at the end of from two to three months.

Of sixty-three cases treated by this method during 1921 to 1937, only twenty-three were reexamined. Sixteen patients were considered to have excellent functional results, in that they complained of no pain and were able to flex the knee to 90 degrees or less. The results in five cases were classified as satisfactory. These patients complained of mild pain and could flex the knee no more than 45 degrees. In two cases ankylosis developed, due to patellofemoral fusion.

SPINA BIFIDA—PROGNOSE; ERBLICHKEIT (Spina Bifida—Prognosis; Transmissibility). Svend Hindse-Nielsen. *Acta Chirurgica Scandinavica*, LXXX, 525, 1938.

The detailed analysis of 357 cases of craniorachischisis which the writer collected from the Danish hospitals is presented in tabular form with illustrative cases. The prognosis is bad, with a tremendous mortality in the first six months in both the operated and non-operated cases. There were four patients with bilocular cysts, and several had multiple medullary lesions with localizing symptoms much higher than the tumor. Among the non-operated cases there was occasional secondary degeneration of the medulla during puberty, probably caused by fixation of the conus medullaris as in spina bifida occulta. The writer recommends operation as a rule only in cases of meningocele or myelocele with few symptoms, leaving those with syringomyelocele to their fate.

Delay in closure of the neural tube takes place before the third foetal week. A personal study of 124 families and a review of the literature suggests the existence of a complicated hereditary rule connected with a sex-determining factor. There is certainly a familial concentration. Family trees and tabular data are offered in an exhaustive discussion of the problem of genesis.—*W. P. Blount, M.D., Milwaukee, Wisconsin.*

SUBLUXATION OF THE HIP TREATED WITH THE STABILIZING OPERATION OF LANCE. Frederik Therkelsen. *Acta Orthopaedica Scandinavica*, IX, 1, 1938.

Out of sixty-eight hips operated upon in sixty-one patients, follow-up examinations were completed on sixty hips in fifty-five patients, one to nine years following the Lance shelf operation. In thirty-three, the results were good; in fourteen, improved; and in thirteen, unimproved, with occasional exaggeration of symptoms. The ages ranged from two and one-half to seventy years, which seemed to have little bearing on the end result. The limp and Trendelenburg's sign disappeared in only a few cases, but there was less pain and limp in most, and the stability and subjective improvement fully justify the procedure.—*W. P. Blount, M.D., Milwaukee, Wisconsin.*

FIVE CASES OF TUBERCULOSIS OF THE SYMPHYSIS PUBIS. Eiler Greger. *Acta Orthopaedica Scandinavica*, IX, 43, 1938.

With five of his own, the writer was able to collect one hundred and thirty cases of tuberculosis of the symphysis pubis. The lesion usually accompanied tuberculosis elsewhere in the body, in both sexes, and at ages ranging from three to seventy years. Indirect injury was a likely predisposing cause in some cases, but pregnancy played no rôle. Pain in the symphysis was frequently absent. Fatigue in the legs, limp, and pain in the hip were early symptoms. An abscess near the symphysis, on the medial aspect of the thigh, or near the anus, often brought the patient to the doctor.

X-rays taken in the prone position showed a "mouse-eaten" appearance of the bones, frequently with sequestrum formation. The horizontal rami of the pubic bones later appeared at different levels. The differential diagnosis was often confusing. Treatment was general with aspiration of abscesses and removal of sequestra. Good results with a bone graft are mentioned. This form of fixation was not tried by the writer, who relied on the support of leather or plaster. Two of the five patients died of multiple tuberculosis.—*W. P. Blount, M.D., Milwaukee, Wisconsin.*

EPIDERMOID CARCINOMA IN OSTEOMYELITIS: CASE REPORT. J. H. Harrison. *The American Journal of Cancer*, XXXII, 527, Apr. 1938.

The author presents a case of epidermoid carcinoma of the leg, developing on the basis of chronic osteomyelitis of the tibia of eighteen years' duration. Pathological fractures of the bone occurred twice within the years prior to the patient's admission with advanced local carcinoma. Mid-thigh amputation and mild prophylactic roentgen-ray treatment directed to the inguinal nodes apparently have brought about a cure.

In a brief review of the literature it is emphasized that these cases are rare and originate usually only after long-continued activity of the osteomyelitis. The tibia is the commonest site, and the malignancy is of low grade and shows no tendency to metastasize. The author concludes: "When epithelial cells during the process of regeneration are exposed to the products of chronic inflammatory exudate for many years, their normal repair is altered to an extent which may eventually result in neoplastic growth."

The report is illustrated with photographs, roentgenograms, and photomicrographs.
—*Grantley W. Taylor, M.D., Boston, Massachusetts.*

AN EVALUATION OF EXCISION IN THE TREATMENT OF UNUNITED FRACTURE OF THE CARPAL SCAPHOID (NAVICULAR) BONE. Arthur J. Davidson and M. Thomas Horwitz. *Annals of Surgery*, CVIII, 291, Aug. 1938.

Despite the progress made in the treatment of ununited fractures of the carpal scaphoid, a small but definite percentage fail to unite. Many of these fractures are not recognized until irreparable damage has occurred.

The authors realize that good results have been attained in cases of delayed or early non-union by prolonged fixation in a non-padded plaster cast as recommended by Böhler; also by the method of multiple drilling and by the use of an autogenous bone peg.

They feel, however, that total excision still has a very definite place in the treatment of these cases and is the treatment of choice in irreducible fractures, in badly comminuted fractures of the scaphoid (especially those associated with other carpal injuries such as a dislocated semilunar bone), and in neglected cases of non-union with marked and irreparable degeneration of the fragments. In cases where early return to work is essential, and which show obvious non-union and persistent disability, they also advise total excision following a fair but not too prolonged conservative regimen.

They state that early excision will result in a normally functioning and painless wrist with little or no deformity. The efficiency of the procedure diminishes, however, with delay because of the development of arthritic and periarthritic changes in the wrist. They advise against partial excision, as the disability is liable to persist after the procedure.

The authors use a dorsal incision, two inches long, lateral and parallel to the tendon of the extensor pollicis longus. The wrist is immobilized from seven to ten days, and thereafter motion is encouraged.

They analyze eight cases, all in males between the ages of twenty-one and forty-nine years. Seven cases had total excision and one had partial excision. Results were very good or excellent in five cases, good in two cases, and poor in one case. The latter case was one of seven years' duration with marked osteo-arthritic changes.

The authors conclude that "total excision must be considered in the rational therapy of ununited fracture of the carpal scaphoid. . . . When utilized early before secondary arthritic and periarthritic changes take place, a very satisfactory result with regard to anatomic, functional and economic recovery may be anticipated."—*O. B. Bolibaugh, M.D., San Francisco, California.*

THE OSSEOUS SYSTEM IN HODGKIN'S DISEASE. Hyman S. Abrams. *Annals of Surgery*, CVIII, 296, Aug. 1938.

The author is of the opinion that the incidence of bone involvement in Hodgkin's disease is greater than is commonly believed. He was unable to find any comprehensive statistics on the subject. The terminology is confusing, as leukemia, lymphosarcoma, and Hodgkin's disease have all been classified as lymphoblastoma.

Some authors have reported an incidence of 10 per cent., while others believe that all cases have bone involvement at some time during the disease. Symmers found osseous changes in seven of his fifteen cases. Craver and Copeland reported an involvement of 15.7 per cent. in 172 patients with Hodgkin's disease.

The author discusses ten consecutive unselected cases referred to the Radiation Therapy Department of the Brooklyn Cancer Institute with a diagnosis of Hodgkin's disease. Of these, eight proved to be Hodgkin's disease. Four of these patients had typical bone lesions, two showed changes characteristic of Hodgkin's disease, and the other two showed no bone changes.

Some authors have reported osseous invasion before lymph-node involvement, which raises the question of where primary involvement occurs.

Lesions are usually multiple and occur, in order of frequency, in the spine, pelvis, sternum, ribs, skull, and extremities. The roentgenographic appearance may be osteolytic, osteoplastic, or a combination of the two. Hodgkin's disease of the bone may be confused with changes due to carcinoma, multiple myeloma, chronic osteomyelitis, Ewing's tumor, hypernephroma, tuberculosis, leukemia, lymphosarcoma, and cysts. Symptoms depend upon the location of the lesion and the degree of functional impairment, and therefore vary from no pain to excruciating pain, marked impairment of function, pathological fractures, etc.

Roentgenotherapy offers palliation, remission, and retardation of the progress of the disease in many cases.

The author presents briefly the history of two cases. He emphasizes the importance of early diagnosis and treatment of Hodgkin's disease of the osseous system. The possi-

bility of Hodgkin's disease should always be considered in cases showing atypical bone lesions and unusual clinical manifestations.—*O. B. Bolibaugh, M.D., San Francisco, California.*

SCIATICA AND ITS TREATMENT. B. L. Chopra. *The Antiseptic*, XXXV, 329, Apr. 1938.

In discussing the treatment of sciatica, the author recognzies the importance of finding and eliminating focal infections in the teeth, the nose, and the tonsils. In addition to other measures, he finds the most useful form of treatment to be that of massive injections of five ounces of sterile, normal salt solution in the region of the sciatic nerve at the site of its exit from the pelvis. Three such injections are given on alternate days. Relief from pain was general and permanent cure was effected in a number of cases.—*Robert M. Green, M.D., Boston, Massachusetts.*

TUMORS OF THE SPINE. WITH A CONSIDERATION OF EWING'S SARCOMA. Robert R. Rix and Charles F. Geschickter. *Archives of Surgery*, XXXVI, 899, June 1938.

Two hundred and ninety-one tumors affecting the bone structure of the spinal column, available for study in the Surgical Pathological Laboratory of the Johns Hopkins Hospital, are analyzed. All of these tumors were demonstrable roentgenographically.

In the order of their frequency they are: metastatic carcinoma, primary tumors of the spinal column, glial tumors, tumors of the neural sheath of the spinal cord, tumors of generalized distribution, tumors of the sympathetic nervous system, and tumors of teratological origin.

The metastatic carcinoma is the most common neoplasm of the vertebral column and usually originates either in the breast, when it is multiple and destructive, or in the prostate, when it usually involves the lower spine and has osteogenetic characteristics.

Of the primary tumors of the spine, the malignant sarcomata are found to include chondrosarcoma, osteolytic sarcoma, and sclerosing sarcoma. These may be secondary to multiple exostoses or to Paget's disease. Chordoma affects the upper and the lower ends of the spine of the adult and produces a destructive lesion.

The benign growths include the giant-cell tumor and the osteochondroma. Hemangioma is rare.

There were twelve neuroblastic tumors. No typical Ewing's sarcoma of the spine was found.

The differential diagnosis is discussed, and there are numerous illustrations.—*I. William Nachlas, M.D., Baltimore, Maryland.*

SPONDYLOLISTHESIS. TREATMENT BY ANTERIOR BONE GRAFT. Kellogg Speed. *Archives of Surgery*, XXXVII, 175, August 1938.

Speed analyzes the causes of anterior slipping of the body of the vertebra in spondylolisthesis and finds that the condition is usually associated with a defect in the bony structure of the neural arch. Because of this, a fusion of the spine through the spinous processes is not enough to prevent the anterior slipping of the body. He quotes statistics on the end results of the posterior spine fusion to substantiate this. It is his belief that the solution to the problem is a fusion through an anterior approach, designed to anchor the body of the slipping vertebra. He describes his technique to accomplish this and reports a case in which he performed this operation.—*I. Willam Nachlas, M.D., Baltimore, Maryland.*

FRATTURA-LUSSAZIONE TOTALE BILATERALE SIMMETRICA DELLA ARTICOLAZIONE DI LISFRANC (Bilateral Symmetrical Complete Fracture-Dislocation of Lisfranc's Joint). Antonio Moratti. *Archivio di Ortopedia*, LIII, 505, 1937.

In this article, Moratti reports a case of this unusual injury. A woman, twenty-one

years old, jumped from a balcony about five and one-half meters high. She landed on her feet, fell, and could not get up again. Roentgenographic examination revealed lateral displacement of the metatarsal bones, the first and second being displaced dorsally, also. Attempts at closed reduction being unsuccessful, open reduction was performed and the joint between the first metatarsal bone and the cuneiform bone was fused. Excellent clinical results were obtained.—*Ernst Freund, M.D., Los Angeles, California.*

La cura ortopedico-chirurgica della poliartrite cronica primitiva (Treatment by Orthopaedic Surgery of Chronic Primary Polyarthritis). Riccardo Galeazzi. *Archivio di Ortopedia*, LIII, 521, 1937.

In this article, Prof. Galeazzi gives a general review of the subject as presented at the meeting of the Italian Committee for the Control of Rheumatism. The great social importance of chronic infectious polyarthritis is emphasized inasmuch as it forms statistically a high percentage among the causes of invalidism. The classification into an infectious inflammatory type and a degenerative form is maintained. The idea of Oppel that primary chronic polyarthritis is of endocrine origin, due to a disturbed function of the parathyroid glands, and that it can be cured by a partial removal of these glands, has not been confirmed by the results. As long as the real cause of infectious polyarthritis is unknown, orthopaedic surgery cannot lead to radical cure, but is of great help in preserving, improving, and restoring joint motion. It has to deal with the different manifestations of the disease,—pain, circulatory disturbances, contractures, joint effusions, and alteration of joint motion. The inflammatory nature of the disease makes it necessary that orthopaedic treatment be applied very carefully and gradually, because there exists constantly the danger of exacerbation. Conservative treatment is preferable to surgery. A complete synovectomy is a very reasonable form of surgical intervention. Other operations, such as arthroplasty or arthrodesis, should be done only after a wise selection of cases. Periarterial sympathectomy and ganglionectomy influence only the circulatory disturbances and are not of lasting effect.—*Ernst Freund, M.D., Los Angeles, California.*

Semeiologia clinica della claudicazione (Clinical Symptomatology of Limping). Antonio Poli. *Archivio di Ortopedia*, LIII, 543, 1937.

This paper, prepared as a report for the twenty-eighth Congress of the Italian Society of Orthopaedic Surgery and Traumatology, gives a careful review of the literature with discussion of the normal gait and its analysis, including Scherb's and Schwartz's experiments. The second part is devoted to the pathological gait and the different forms of limping attributed to various factors, among which are mentioned: pain affecting the lower extremities or the trunk; difference in length of the lower extremities—either simple, due to fractures of the diaphysis or to hypoplasia, or complicated, as by congenital dislocation of the hip, coxa vara, coxa valga, etc.; alteration of joint motion; stiffness or complete ankylosis; alteration of the muscular apparatus; infantile paralysis; spastic paralysis; Little's disease, etc. The paper represents a good review without adding any original thought.—*Ernst Freund, M.D., Los Angeles, California.*

The Modern Treatment and Results of Treatment of Fractures of the Neck of the Femur. Ernest W. Hey Groves. *British Medical Journal*, II, 359, 1937.

The Smith-Petersen nail is designated as "a wonderful example of the triumph of practice over theory", and the rapid adoption of this method in the treatment of femoral-neck fractures is due to the "very quick, immediate restoration of function which it affords". In comparison with the original Whitman procedure, which resulted in bony union in from 50 to 60 per cent. of the cases, the author believes that the intelligent use of the Smith-Petersen nail will bring success in 75 per cent. of these cases.

In discussing methods of application of the nail, Hey Groves believes that neither the open operation nor blind insertion of the nail over wire guides is justified in old and

feeble patients—the individuals who constitute the real problem in this fracture. Instead, blind insertion of the nail with the help of a mechanical director is advocated. This director consists of two prongs,—one inserted into the mid-femoral head; the other, into the base of the femoral neck. A drill can thus be passed accurately into the bone in the true axis of the femoral neck. The operation is bloodless; it is performed under gas-oxygen anaesthesia; and it requires from ten to fifteen minutes. The nail is removed in three months.

In late cases with definite non-union, the author favors a bifurcation osteotomy. This procedure is simple and involves no shock or hemorrhage, and the Y-shaped upper end of the femur will support body weight from the lower margin of the acetabulum while abduction of the leg is substituted for adduction, and thus leg shortening is reduced.—*G. E. Haggart, M.D., Boston, Massachusetts.*

Injuries in the Region of the Shoulder Joint. I. Capsule and Tendon Injuries. R. Watson-Jones. *British Medical Journal*, II, 29, July 2, 1938.

The author notes that the majority of painful shoulders are due to minor injuries of the supraspinatus tendon, and that complete rupture, although rarely diagnosed, is a common and disabling industrial accident. Dramatic results may be secured in this condition by injecting 2-per-cent. novocain into the painful region. If the symptoms are incompletely relieved by injection, diathermy and radiant heat are of value in encouraging the necessary revascularization. Small calcareous deposits in this region should be treated conservatively by diathermy, radiant heat, and massage. Large deposits should be removed surgically. Most cases of complete rupture of the supraspinatus tendon can be successfully treated conservatively by maintaining the arm in 90 degrees of abduction and in external rotation upon a plank for at least eight weeks. In cases where periarticular adhesions have formed, manipulation under anaesthesia should not be used except as a last resort. Much can be gained by exercises without forcible movement.—*James W. Toumey, Jr., M.D., Boston, Massachusetts.*

Injuries in the Region of the Shoulder Joint. II. Bone and Joint Injuries. R. Watson-Jones. *British Medical Journal*, II, 80, July 9, 1938.

For ordinary fractures of the clavicle, the author employs the figure-of-eight bandage. The finger, wrist, and elbow joints must be exercised frequently from the first day. The author describes a simple form of strapping for an acromioclavicular dislocation, which gives excellent results and which makes operative measures unnecessary, even when the ligaments between the coracoid and the clavicle are torn. In dislocations of the shoulder with paralysis of the deltoid, this muscle must be relaxed by abducting the shoulder in a frame. In the after-treatment of shoulder dislocation, passive stretching and manipulation under anaesthesia should be rigidly avoided.

In cases of contusion and fracture of the neck of the humerus, complete immobilization is not necessary. The limb should be supported in a sling for from two to three weeks. It is a serious mistake to believe that every fracture of the upper end of the humerus should be treated in abduction. In abduction fractures, the shaft is already abducted on the head, and an abduction frame will perpetuate or increase this displacement. As a rule, the displacement is not of a serious degree and does not require manipulation. The limb is supported in a sling in the adducted position by the side of the trunk.—*James W. Toumey, Jr., M.D., Boston, Massachusetts.*

Brodie's Abscess and Its Differential Diagnosis. James F. Brailsford. *British Medical Journal*, II, 119, July 16, 1938.

The author studied sixty-two cases of Brodie's abscess and found that the lesion occurred twice as often in the male as in the female. The majority occurred in the age period between eleven and thirty years. Over one-third of the total number of abscesses were found in the lower end of the tibia. Except in a very few instances, the primary

lesion seemed to be in the metaphyseal extremity of the diaphysis. As in acute osteomyelitis, the infecting organism found in the majority of cases was staphylococcus aureus. There is perhaps no other lesion in which the clinical history of the patient is more helpful in diagnosis. The clinical history indicates the age of the lesion and the existence of any previous septic focus or infection likely to be associated with bone abscess. Such information is invaluable in view of the fact that lesions of a widely different significance produce a rather similar appearance in the roentgenogram. Such lesions are tuberculous abscess, gumma, simple bone cyst, sarcoma, and endothelioma. In the case of a tuberculous abscess, the process does not appear to be checked by the growth cartilage at the metaphysis and prevented from invading the epiphysis, as is the usual feature of the staphylococcal abscess. Gumma of the bone is usually identified by the massive reaction which it produces in the adjacent bone. The simple bone cyst expands the bone, and its boundary is but a thin wall of bone, which appears to be yielding to pressure of its contents. There is usually no evidence of new periosteal bone. There is a type of sarcoma which starts in the medulla by destroying adjacent bone and by producing an abscess-like cavity. Its boundaries are not clearly defined, as in the case of the simple bone cyst. Endothelial myeloma of the bone occurs at about the same age periods as does the chronic bone abscess. Serial roentgenograms of the lesion will usually suffice for identification.—*James W. Toumey, Jr., M.D., Boston, Massachusetts.*

INJURIES TO THE ELBOW-JOINT. S. L. Higgs. *British Medical Journal*, II, 189, July 23, 1938.

Tennis Elbow: The diagnosis is easily made if typical pain occurs when the wrist is actively extended against resistance and the forearm is supinated. With maintenance of active extension, the pain can be localized in one or more of three usual situations, all beneath the common origin of the extensor-supinator group of muscles. The first and most usual is over the radiohumeral joint; the second, slightly higher up in the region of the lateral epicondyle; and the third and least frequent, more forward between the bulky part of the muscle origin. Treatment at the onset is simple physiotherapy, rest, heat, and avoidance of painful motion. In the early chronic stage, which may last a year or more, certain cure can be obtained by operation. A slightly curved incision, four inches long, is made on the outer side of the elbow behind the lateral epicondyle; the muscles of the extensor-supinator group are reflected from the epicondyle and capsule of the radiohumeral joint. Definite pathological tissue is excised, and the muscles are resutured. The arm is usually strong and comfortable by the end of from two to three weeks. Manipulation is effective in the late chronic stage. The author advocates the Mills method, and thinks it can be done without an anaesthetic, although with local injection of novocain it is much less painful.

Dislocations and Sprains: Posterior dislocation is the most common, and diagnosis is obvious. In such cases, reduction is easy and is obtained by steady traction on the forearm in the line of the limb. In older dislocations, hyperextension of the joint will lever the coronoid process over the humeral surface. The arm is then put up in fairly full flexion, and is carefully observed in case swelling should develop. The author feels that it is better to immobilize the elbow in a molded posterior slab of plaster for a fortnight than to attempt early active motion. He also emphasizes the fact that the resumption of the range of motion and activity of the arm should be left to the patient's own efforts. Massage, stretching, and forceful measures of any kind are not indicated. If myositis ossificans develops, complete fixation of the joint for a long period is essential; immobilization is again obtained by the posterior plaster splint as described. In those cases in which a definite bone block exists after the process has become quiescent, the growth is removed by operation. Treatment of old dislocations is similar to that described for the more recent cases. The author feels that open operation is rarely either necessary or satisfactory, as it entails too much injury to the soft parts and subsequent stiffness.—*G. E. Haggart, M.D., Boston, Massachusetts.*

VUE D'ENSEMBLE SUR LE TRAITEMENT CHIRURGICAL DE LA TUBERCULOSE DU PIED ET DU COUP-DE-PIED. Jacques Calvé. *Bulletin de la Société Belge d'Orthopédie, et de Chirurgie de l'Appareil Moteur*, X, 175, 1938.

Calvé states that tuberculous infection accentuates the anatomical differences between the foot of an adult and of a child. In small children the great amount of cartilage surrounding the bony nucleus of the tarsal bone preserves the form of the bone and protects the articulations from infection.

In the child, healing may occur or a fistula may develop. A minimum of two years is required for healing. During this period there should be complete immobilization and no attempt at standing. If healing is long delayed, in tibiotarsal infection, one may perform an astragalectomy. Where secondary infection has occurred, adequate drainage is the first essential. Astragalectomy is advised for drainage in the posterior part of the foot. For the distal tarsal bones, bilateral drainage is advocated with resection of bone if necessary. Often healing is surprisingly good. The shape of the foot should be preserved if possible. Amputation should never be performed in children. Constant watch must be kept to prevent severe deformity.

In a fair number of adults, healing occurs after prolonged immobilization. Where healing does not occur and secondary infection intervenes, amputation of the foot offers the best chance of cure. Resections and astragalectomy should not be performed in adults.—*John G. Kuhns, M.D., Boston, Massachusetts.*

ANOMALIES OF THE SPINE. Wilbur Bailey and Ray A. Carter. *California and Western Medicine*, XLIX, 46, July 1938.

The authors found that 67 per cent. of spines show anomalies. A detailed discussion of the development of the spine and the origin of anomalies is given. Since the spine is very complicated, the anomalies are exceedingly variable, and involve all the different anatomical structures. These, as well as the persistent epiphyses of the vertebral processes, often have to be differentiated from fractures. There are certain features, such as location and character of the borders of the separation, which serve to make the differentiation evident. Abnormal fusion of vertebrae or hemivertebrae and fusion of spinous processes and even of bodies of vertebrae are seen. One is attracted by the frequency of anomalies in the transitional vertebrae in the cervicothoracic, thoracolumbar, and sacrolumbar areas. The so-called sacralization of the lateral processes of the fifth lumbar vertebra is seen, though not so often as is reported.

As to symptoms arising from these anomalies, such as cervical ribs and variations in the fifth lumbar vertebra, the authors question the prevalent belief that they are the causes of pain and disability, and quote from a report by Dr. Bohart of the Belt Railway Company of Chicago, that almost no back symptoms could be attributed to vertebral anomalies. The authors found that only about once in ten cases, where symptoms indicated a cervical-rib involvement, did they find one present. Lumbar ribs occur in 10 per cent. of all cases and are without symptoms.—*Charles Lyle Hawk, M.D., Los Angeles, California.*

ADAMANTINOMA. A CLINICAL STUDY OF TWENTY-SIX CASES. H. T. Kimm and A. F. Baranoff. *The Chinese Medical Journal*, LIII, 1, 1938.

The authors discuss the incidence, etiology, diagnosis, treatment, and end results of twenty-six cases of adamantinoma of the jaw, which were seen in the Surgical Clinic of the Peiping Union Medical College Hospital, Peiping, China. Out of a total number of 350 tumors of the jaw that were observed, the incidence of adamantinoma was approximately 7.4 per cent.

Among the Chinese, these tumors were most frequently seen in individuals between the ages of thirty and thirty-five years, although the age incidence may range between early childhood and old age.

The sex incidence showed a preponderance of males, which is contrary to the usual findings, since most authors state that there is a definite preponderance of females.

All of the cases reported occurred in the jaw, and, of the twenty-six cases, twenty-two occurred in the mandible and four in the maxilla.

The authors agree with previous writers that the tumor is of very slow growth, in one case being of fifty-one years' duration. The two different types of adamantinoma, cystic and solid, are discussed, and the point made that practically all these tumors are polycystic in character, there having been only one solid tumor among the cases reported.

The authors reaffirm the etiology of adamantinoma as arising from the peridental epithelial debris of Malassez, and believe that trauma, infection, or continued irritation are contributory factors in stimulating tumor growth. They do not discuss the histogenesis or pathology of the tumor.

The question of the malignancy of these tumors is also considered, and the series of cases reported indicates, as do all previous reports, that the adamantinoma is locally malignant and exhibits a definite tendency to local infiltration and recurrence. These tumors, in the experience of the authors, metastasize rarely, if ever, and none of the cases studied showed any evidence of metastases.

The diagnosis of adamantinoma of the jaw is sometimes difficult, but usually can be made by the following findings: a slowly growing symptomless tumor with an onset of toothache and local pain which disappears later. This history plus the good general condition of the patient, the location of the tumor, the absence of metastases, and the roentgenological picture of a central destructive tumor without peridental reaction, help to make the diagnosis. Differential diagnosis excluded giant-cell tumor, central fibroma, dentigerous cyst, dental-root cyst, malignant tumors, and osteomyelitis. In the opinion of the authors all central tumors of the jaws should be considered as adamantinomata until proved otherwise.

The treatment of adamantinoma should be mainly surgical, and marked emphasis is placed upon the importance of radical surgery. Radiation has not been successful among Chinese patients, and the tumor is known to be essentially radioresistant. Complete excision of the tumor with wide resection of the surrounding bone is the treatment which in their opinion yields the best results.

So far as end results are concerned, the authors state that they have not known of a single recurrence of the tumor among their cases and they believe that, on account of the low degree of malignancy of the tumor, radical excision should be followed by a high percentage of satisfactory results. Sufficient time had not elapsed to allow them to give absolute end results.—*George Van Gorder, M.D., Boston, Massachusetts.*

THE ORTHOPAEDIC TREATMENT OF POLIOMYELITIS INVOLVING THE SOFT PARTS. F. Raszeja. *Chirurgja Narzadów Ruchi i Orthopedja Polska*, XI, 35, 1938.

This is an extensive article describing the method of treatment used by the author in eighty-two cases in the past five years. Paralysis of the lower extremity predominated; the upper extremity was affected in a small number of cases. The article is divided into six sections dealing with statistics, conservative treatment at the onset, operations on the nerves, tenotomies, tenodeses, and fasciodeses. In the last two parts the various tenoplastic operations are considered. The author does not perform important tenoplastic operations on children younger than five years. Tenotomies and tendon lengthening, or fasciodeses, are performed in this group. The author gives a historical and bibliographical review of the literature on tenoplastic operations, with a biological exposition of the entire problem. The value of tendon transplantation is found to be very limited. The various bone operations for stabilization of the foot are used in cases where the transplantations are not sufficient. Lange's operation for gluteus weakness was used successfully in five cases. In the lower extremity the author reports an average of 30 to 40 per cent. improvement. He finds it difficult to replace the function of the deltoid.—*Emanuel Kaplan, M.D., New York, N. Y.*

CONSIDERAZIONI CLINICHE SULLA FRATTURA DA STRAPPAMENTO DELLA SPINA ILIACA ANTERIORE SUPERIORE (Clinical Considerations of Avulsion Fracture of the Anterior Superior Iliac Spine). Andrea Padula. *La Chirurgia degli Organi di Movimento*, XXIII, 69, 1937.

Three cases of this type of fracture in young athletes are reported. In two cases the injury was sustained when the patients were kicking soccer balls, and in the third case the patient was injured in starting a foot race. The mechanism of the avulsion is not the same in all cases. When the sartorius and tensor fasciae latae are strained in stabilizing the pelvis while the opposite foot is off the ground (as in kicking a ball), they may pull off the spine, and, with the leg in internal rotation (while kicking the ball), avulsion of the spine on the side of the kicking leg results.

Localized tenderness and inability to flex the leg or trunk or to lower the knee when the heel on the affected side was placed on the opposite knee were symptoms in all cases.

Simple immobilization with an adhesive belt, five centimeters wide, about the pelvis, resulted in marked improvement in from three to six days, with recovery from symptoms in a month. Check-up roentgenograms, taken eight and twelve months after injury, showed fusion of the anterior superior spine in two cases.—*A. W. Ciani, M.D., Iowa City, Iowa.*

SCIATICA PARALIZZANTE DA ERNIA POSTERIORE DI UN DISCO LOMBARE DEGENERATO (Paralyzing Sciatica from Posterior Herniation of a Degenerated Lumbar Intervertebral Disc). M. Paltrinieri. *La Chirurgia degli Organi di Movimento*, XXIII, 97, 1937.

The author reports the case of a woman, fifty-three years of age, who had complained of intermittent pain along the course of the left sciatic nerve for ten years. Following an acute exacerbation, foot-drop developed. Studies revealed narrowing of the disc between the fourth and fifth lumbar vertebrae and compression of the lipiodol column at this level. Spinal-fluid findings were negative. The patient refused surgery, and the case is reported merely to emphasize that one should not be satisfied with a simple diagnosis of sciatica, but should investigate every such case thoroughly.

Anatomical researches by Andrae showed herniated discs in 15.2 per cent. of 368 spinal columns. These were usually in individuals between the ages of fifty and eighty, and very rarely under thirty. According to Alajouanine and Petit-Dutaillis, herniation may depend on trauma or previous disc changes. If trauma is mild or absent, as in the case presented, it is fair to assume that some degenerative changes were present in the disc prior to herniation. According to certain authors, involutional changes in the disc begin in the third or fourth decade of life, and associated degenerative changes favor posterior herniation of the disc. Herniae found by anatomists usually present zones of degeneration. In fact, Dandy, Bucy, and the author support the theory that already existing disc changes invariably precede herniation.—*A. W. Ciani, M.D., Iowa City, Iowa.*

ZUR PATHOLOGIE DER BILATERALEN WIRBELKÖRPERFEHLBILDUNGEN UND ZUR NORMALEN ENTWICKLUNG DER WIRBELKÖRPER (The Pathology of the Development of Bilateral Defects in Vertebral Bodies). Karl Hartmann. *Fortschritte auf dem Gebiete der Röntgenstrahlen*, LV, 531, 1937.

There are two types of anomalies with bilateral developmental defects in vertebral bodies: (1) the formation of a complete gap in a vertebral body, or an anterior spina bifida; (2) the presence of two distinct ossification nuclei in a vertebral body, or bipartite vertebral body.

In the anterior spina bifida, there exists a paired notochord separated by a gap. Each half of the vertebral body is lateral to its respective notochord. The notochordal rudiments fail to unite and an anterior spina bifida results. The author believes that the

bipartite vertebral body with its bilateral ossification centers has a similar mode of origin, except that the vertebral bodies are in closer approximation, thereby destroying or making it difficult to identify the two notochord halves.

The author discards the widely held view that the binucleate vertebral body is due to bilateral deposit of the cartilaginous and osseous centers.—*Harold Unger, M.D., Iowa City, Iowa.*

THE INDUSTRIAL PHYSICIANS AND SURGEONS. *Industrial Medicine*, VII, 367, July 1938.

This is a comprehensive report of the Twenty-Third Annual Meeting of the American Association of Industrial Physicians and Surgeons and the Second Midwest Conference on Occupational Diseases, held in Chicago from June 6 to 9, 1938. The scientific program for the four days is given, and the excellence of the papers is stressed. Thirteen of the thirty-five papers which were presented are included in the same issue of *Industrial Medicine*, and the remainder will be published in the August and September numbers.

IMPORTANCE OF RESTORATION OF BLOOD SUPPLY IN FRACTURES OF NECK OF FEMUR. Fred H. Albee. *Journal of the American Medical Association*, CX, 2044, June 18, 1938.

The author believes that the possibility of an inadequate blood supply to the femoral head makes the treatment of subcapital or central fractures a special problem. Even though union of the fracture might be obtained, aseptic necrosis of the head might follow.

Since subcapital or central fractures may be wholly intra-articular, the only blood supply available for the head is through the ligamentum teres. Wolcott found in a study of cadavera that in 15 per cent. the ligamentum teres did not have vessels of sufficient size for the injection of mercury.

The author has performed 413 reconstruction operations for non-union of and/or absorption of the femoral neck. In more than 70 per cent. of the cases all ligamentous tissue appeared to have been avulsed from the cotyloid notch. In only two cases was the ligamentum teres found to be intact. It is believed that the rotation of the femoral head, incidental to the femoral-neck fracture, tears or avulses the ligamentum teres. If this ligament remains intact, as in primary impacted cases, it will continue as a source of blood supply to the head. The author feels that the intactness of the ligamentum teres is the determining factor in cases of non-union.

In partial or complete extracapsular fractures, the fragment is so long that it cannot be rotated under the rim of the acetabulum, thereby preserving the ligamentum teres. However, in these fractures the adherent soft structures convey blood to both sides of the fracture site. Thus the prognosis for a satisfactory result is good.

For internal fixation, the autogenous bone-graft peg is most effective. The author has previously reported successful results in 94 per cent. of his cases. In three cases the graft bridged a hiatus of from one-half to two-thirds of an inch between the fragments. The graft carries blood to the anaemic femoral head, furnishes adequate immobilization, and brings an osteogenic, callus-forming material to the fracture junction. Whether the bone-graft-peg operation should be employed as the primary treatment in subcapital or central fractures is for the patient and the surgeon to decide. It should, however, be used in this type of fracture at the earliest signs of non-union.—*H. M. Childress, M.D., Dallas, Texas.*

THE CARE AND TREATMENT OF CEREBRAL PALSIES. Winthrop Morgan Phelps. *Journal of the American Medical Association*, CXI, 1, July 2, 1938.

Before considering the care of cerebral palsies, it is necessary first to determine the exact aim in treatment. The gait of the child and his emotional behavior are both im-

portant. It is a problem for the orthopaedic, the psychological, and the educational fields.

There are two general types of injury which may cause cerebral spasticity. The cortical type of injury, due usually to unskilled use of forceps, produces definite spasticity. The basilar type, due to hemorrhage into the basal nuclei from a tear of the tentorium and the vein of Galen, produces athetosis, tremor, or incoordination. Either of the two forms of palsy may result from a congenital defect or from encephalitis.

A distinct differentiation must be made between spasticity and athetosis, since the treatment for each is not the same. The repetitive method of instruction, for instance, is valuable for spastic cases, but is generally unsuccessful in teaching athetoid patients. The athetoid child reacts to his involuntary motion by voluntary tension. This becomes habitual if he is not taught to relax as much as possible. Thus relaxation must be the foundation upon which future progress is made.

A regimen of treatment should be mapped out and properly timed for each individual case. Instruction should be given in simple motor coordination, behavior regulation, and the simplest control of psychological reactions to situations. Surgery is indicated most often in the spastic group. In severe athetosis, however, section of the lateral columns of the cord may be of some benefit.—*E. P. Legg, M.D., Dallas, Texas.*

PROTRUDED INTERVERTEBRAL DISKS. J. Grafton Love and Maurice N. Walsh. *Journal of the American Medical Association*, CXI, 396, July 30, 1938.

The authors base their report upon 100 cases of protrusion of intervertebral discs. It was noted that most of the discs were found in the region of the greatest convexity or concavity of the spine. This was accepted as indirect evidence that the lesion is secondary to mechanical trauma, since the vertebrae at these areas are subjected to great strain.

In 84 per cent. of these cases there was a definite history of intermittent symptoms. This periodic pain is explained by the fact that in some instances the projected disc returns to its normal intervertebral position, particularly following kyphotic flexion. This fact was verified in a cadaver.

There were eighty-eight cases of protruded lumbar discs. A history of injury was definitely connected with the onset of symptoms in only 34 per cent. Unsuccessful were efforts to determine the exact site of the lesion by means of reflex changes, muscle weakness, and segmental sensory loss. In the majority of cases the sensory impairment occurred in segments below the actual lesion. This may be explained by pressure on the roots of the cauda equina as they pass over the bulging disc. Total protein of the spinal fluid was forty milligrams or more per 100 cubic centimeters in 80 per cent. of the cases studied.

The operative procedure consisted of either extradural or transdural removal of the protruded portion of the disc. The removal of two spines and two laminae usually gave sufficient exposure. The articulating facets were preserved, the ligamenta flava were removed for lateral approach, and the iodized oil was removed at operation. In no case was a spine fusion done, and in no instance was there a return of the patient's original symptoms.—*H. M. Childress, M.D., Dallas, Texas.*

INFANTILE CEREBRAL PALSY (SPASTIC PARALYSIS). Clarence H. Heyman. *Journal of the American Medical Association*, CXI, 493, Aug. 6, 1938.

This paper is based on 1000 cases of cerebral spastic paralysis. The author recognizes the importance of birth trauma as an etiological factor, but believes that it has been given undue prominence.

The term "Little's disease", as now used, includes every type of palsy developing at or from the time of birth. There should be further division, as Little's disease,

accurately speaking, is diplegia associated with difficult or abnormal birth. Birth trauma, however, is not necessarily a factor in diplegia.

The etiological factors, as classified by Hutinel and Babonneix, are given under the headings of causes operating:

Before conception:

Toxins, infections, neuropathic heredity, and consanguinity.

During pregnancy:

Intoxication, primary degeneration, gross developmental defects, and lues.

At delivery:

Premature birth, difficult delivery at term, asphyxia, anoxaemia, and air embolism.

During the first few months of life:

Acute infectious diseases.

In the first group of causal factors, alcoholism is the only established toxin, whereas syphilis is the most common infection. Heredity may be a cause but consanguinity is not acceptable as a factor.

Intoxications of pregnancy may make the blood vessels of the foetal brain vulnerable to rupture, may produce premature birth, or may cause degenerative brain lesions. However, a primary arrest or a developmental defect of the brain, which is associated with spasticity, is difficult to explain on a basis of trauma or vascular accident.

Premature birth may be a causative factor of Little's disease, but is not inseparably connected with the condition. It is reasonable to believe that the same condition produces both the prematurity and the congenital muscle rigidity. Trauma to the brain at birth is common and there is a difference of opinion as to the relationship of brain hemorrhage at birth to Little's disease. Asphyxia and anoxaemia are closely associated with this hemorrhage and all three conditions may be related etiological factors.

The author concludes that Little's disease is not a distinct clinical entity and that, at present, it is not possible to find a cause which applies indiscriminately to all cases.

—H. M. Childress, M.D., Dallas, Texas.

AN OPERATION FOR PARALYSIS OF THE INTRINSIC MUSCLES OF THE THUMB. N. D. Royle. *Journal of the American Medical Association*, CXI, 612, Aug. 13, 1938.

The author presents a new method of muscle transplantation for paralysis of the intrinsic muscles of the thumb.

The operation is performed as follows: A transverse incision is made at the base of the fourth finger and the bifurcated sublimis tendon is released at its insertion. The sheath of the flexor pollicis longus is opened and the sublimis tendon is drawn down through the sheath. One part of the bifurcated tendon is sutured to the attachment of the short flexor muscle with the first phalanx in flexion, and the other part is fixed to the outer edge of the opponens pollicis with the thumb in opposition. The sublimis tendon itself is used as the suture material. The thumb is immobilized for about ten days.

The sublimis tendon to the third or the fifth finger may also be used for the transplant.

The author has employed this operation during many years, with satisfactory results.

—E. P. Legg, M.D., Dallas, Texas.

THE PATHOLOGY OF CARIES SICCA OF THE SHOULDER. Henry Turner. *Messenger of Surgery*, LI, 83, 1937.

Prof. Turner, of Leningrad, in his study of the literature on tuberculous arthritis, points out that the involvement of the joint, the pathology, and the clinical course in the so-called "caries sicca" differs very definitely from tuberculous affections in other joints. The name was given by Volkmann to designate the acute affection accompanied by atrophy of the bone, but without suppuration. The pathology at that time was not

understood, but Volkmann differentiated the condition from those that are associated with the usual forms of tuberculosis, syphilis, or chronic affection.

The description of Volkmann was so definite and so accurate that it has frequently been repeated by other writers who have dealt with this subject, and it has been shown that the destruction of the head of the humerus is principally concentrated in the tubercle and the anatomical neck. According to König, the destructive process is originally located in the sulcus between the tubercles. The subchondral part of the head then undergoes dissolution. Codman states that there is no other disease of the shoulder in which the sulcus is so depressed and enlarged at the expense of the head. It is generally believed that the synovial membrane is not visibly affected, yet the most marked element in the clinical syndrome is contraction of the capsule and the ligaments. Loss of motion, approaching ankylosis, is the inevitable result. As far as is known, there is no special relationship between age and this particular affection.

Prof. Turner states that his interest in this particular condition became active many years ago, and was stimulated by his observations of the insidious and continuous pain in the shoulder and the adjacent regions, and of the rapid impairment of function and the very marked atrophy of the deltoid. Accompanying the atrophy in children, there is marked retardation of the growth of the upper end of the humerus, with a shortening of its entire length. A careful examination of the anatomy and the correlation of the component parts of the syndrome suggest a nerve involvement as the explanation of this form which differs so largely from the ordinary tuberculous joint. Further study reveals evidence of the involvement of the axillary (circumflex) nerve in the early stages of the process. Since its structure corresponds in type to the short nerves, which are principally muscular in their distribution, the axillary nerve regularly gives off a sensitive branch to the integuments of the posterior part of the shoulder. This branch is known as the cutaneous brachii lateralis, and arises from the fifth to the seventh cervical roots. The upper branch winds around the neck of the humerus beneath the deltoid as far as the anterior border of this muscle, giving off cutaneous branches. The lower branch distributes filaments to the teres minor and to the posterior process of the deltoid. The nerve then pierces the deep fascia on its way to the integument between the posterior part of the deltoid muscle and the long head of the triceps. The articular capsule also receives its sensitive innervation from this nerve.

From the anatomical findings, which establish the fact that the axillary nerve controls the power, the sensation, and the function of the shoulder, it would appear that in disease of the shoulder joint the toxic condition affecting this nerve will have an important effect on the structures in this region. Toxic neuritis as a complication of tuberculous arthritis is recognized, although frequently not sufficiently so. In the treatise by Dejerine on diseases of the nervous system, tuberculous neuritis is ranked among the other toxic forms. With the recognition of the affection of the motor and trophic elements of the axillary nerve in caries sicca, it became of further interest to demonstrate the involvement of the sensitive cutaneous filaments of this same nerve trunk. Investigation disclosed a definite area of extreme cutaneous sensibility on the posterior portion of the shoulder below the lateral part of the crista scapulae.

In the examination of the fresh pathological specimens, in conjunction with material obtained by clinical observations, Prof. Turner was particularly impressed by the appearance of two cases in which the humerus showed a considerable amount of shortening. (See Figures 1-A and 1-B.) Examination of these specimens revealed the peculiar destruction combined with a very definite degree of shortening of the humerus as compared with the humerus on the opposite side. In one of the specimens, all traces of the upper epiphysis had disappeared and a newly formed flat surface was observed on the posterior part of the shaft for articulation with the scapula.

The author states that the question might easily be raised: Wherein lies the special propensity of this nerve to be involved in the toxic process originating in the shoulder joint? In few other joints can there be found such close proximity to the skeleton of the main nerve trunk supplying all component parts of this joint. The bicipital groove

FIG. 1-A FIG. 1-B

Two cases of caries sicca of the humerus.

Fig. 1-A: Final stage, showing flattened surface.
Fig. 1-B: Final stage of destruction of the upper end.

serves as a pathway for the gravitation of the toxic material produced in the epiphysis, thereby exposing the nerve to its action. Definite nerve manifestations of the trophic type may then overbalance the immediate effect of tuberculous destruction and produce the indolent dry course of the disease which, up to the present time, has eluded explanation. It is further suggested that the continual atrophic process aids the tendency of the caries sicca toward a spontaneous termination, although after destruction of the joint of many years' duration.

Prof. Turner adds a word in regard to the clinical experience with treatment based upon this theory. In several cases, in an endeavor to obtain the curative effect of treatment of the nerve, he resorted to intra-articular injections of tincture of iodine into the space between the acromion and the head of the humerus, with the hope that the resultant gravitation would aid in freeing the contracted capsule. This procedure was repeated at intervals of weeks and proved to be particularly efficient in these cases.

In this article, Prof. Turner has attempted to explain the unusual course of tuberculous arthritis known by the name of "caries sicca", and he suggests that an early involvement of the axillary nerve by the toxic process, with the resulting trophic disturbance of the entire joint, is responsible for the peculiar clinical characteristics found in this condition.

SPÄTERGEBNISSE NACH SEHNENOPERATIONEN IM BEREICH DER HAND (End Results of Tendon Operations in the Hand). E. Derra und G. Ruberg. *Monatsschrift für Unfallheilkunde und Versicherungsmedizin*, XLV, 20, June 1938.

The authors report the end results of tendon operations in the hand, as observed in the *Chirurgische Universitätsklinik*, in Bonn. On the basis of their studies, they feel convinced that operative correction of severed tendons is in order, with the possible exception of old untreated cases. There is no marked difference between the results obtained in the flexor tendons and those in the extensor tendons. The authors urge primary suture in every possible instance rather than secondary suture, because of the difference in results obtained in the two groups of cases. It is impressed upon the reader that painstaking care of the wound is essential, with particular attention to antisepsis and the technique of suturing. Preferably, the simplest types of suturing procedures are employed. While it is the belief of these authors that the milder injuries may be treated in the Out-Patient Department—particularly when only one tendon is cut—the more severe injuries should be treated in the hospital. It is desirable that this type of injury be handled by one especially qualified to do this kind of work.—*I. William Nachlas, M.D., Baltimore, Maryland.*

BUMPER FRACTURES OF THE TIBIA. Hubbard T. Buckner. *Northwest Medicine*, XXXVII, 102, Apr. 1938.

This fracture is described as a separation of the lateral condyle of the tibia, and is often difficult to retain in place after reduction, even though the leg is held in a plaster cast. It sometimes even escapes roentgenographic detection. The author advocates passing through both condyles a doubled wire with a button at either terminus. The fracture is reduced by a "redresser" vise and the wires are tightened by a special turnbuckle and twisting. Four cases are illustrated by roentgenograms.—*Charles Lyle Hawk, M.D., Los Angeles, California.*

SHELVING OPERATIONS OF THE HIP. John F. LeCocq. *Northwest Medicine*, XXXVII, 107, Apr. 1938.

The author describes his operations for forming a shelf over a dislocated femoral head without too much traction placed upon the femur, and for increasing the size of the upper rim of the shallow acetabulum. He advises such operations in all cases of painful dislocated hips or painful shallow acetabula in young adults and in children over ten years of age. Roentgenograms of three cases, before and after treatment, are shown.—*Charles Lyle Hawk, M.D., Los Angeles, California.*

PARTIAL DEFORMING SPONDYLITIS AND TRAUMA. TRAUMATIC DISCOSIS AS A SOURCE OF SPONDYLOSIS. M. I. Kagan. *Novy Khirurgichesky Arkhiv*, XXXIX, 50, 1937.

The material of study is based on 526 cases of spine injuries observed in the Sklifasovsky Institute of Traumatology from 1932 to 1936.

The author states that the partial deforming spondylitis may be due either to a previous degenerative process of the intervertebral disc or to an acute or chronic injury of the spine. The source of the deforming traumatic partial spondylitis is a chronic traumatic discosis. The rupture of the cartilage and bone plates caused by an injury produces a herniation of the elements of the intervertebral disc, especially of the nucleus pulposus into the spongiosa. The traumatic discosis differs from Schmorl's nodules in that the cartilage plate may not be injured but may show a hyperplasia and abnormal development. In chronic discosis of non-traumatic nature the deformity of the vertebral body never reaches the degree observed in traumatic discosis. Discosis with a wedge deformity of the vertebral body may present diagnostic difficulties, but the clinical picture and the x-ray study will establish the proper diagnosis. The presence of sclerosis

in the spongiosa around the herniated elements and the localization of the destructive process in the cranial and caudal cartilaginous plates will distinguish the chronic process from acute trauma, where no sclerosis is found and where, as a rule, the cranial plate only is impaired.

The author presents a number of x-ray reproductions illustrating the described condition.—*Emanuel Kaplan, M.D., New York, N. Y.*

NEW OBSERVATIONS IN CONGENITAL DISLOCATION OF THE HIP IN THE NEW BORN. V. O. Marx. *Orthopaedia i Travmatologia*, I, 25, 1938.

The incidence of congenital dislocation was found to be 1 per cent. in normal births and 11 per cent. in breach presentations in a group of 8544 infants born in Kharkov in 1937. In the past five years 194 children with congenital dislocation of the hip were under actual observation.

The author observed a large percentage of spontaneous reductions. He states that spontaneous reductions were noted in the first few days of life in 47.4 per cent. and in later months in 17.5 per cent. of cases studied in the special maternity institution of Kharkov.

The treatment consisted in the early application of a duraluminum apparatus. The author presents an analysis of the treated cases and summarizes his conclusions as follows: The most reliable sign of a very early dislocation is the presence of slipping, and all the others are of secondary importance; preluxation is much more frequent in breach presentations; spontaneous reductions in the first days of life are a frequent occurrence but must be under observation for two to three and one-half years. The disappearance of clinical and x-ray evidences of dislocation in early life may not coincide with a definite reduction.—*Emanuel Kaplan, M.D., New York, N.Y.*

MALADIE DE STEINERT SANS MYOTONIE (Steinert's Disease without Myotonia). Roma Amyot. *La Presse Médicale*, XLVI, 188, 1938.

The author reports a case of familial hereditary atrophic myotonia. Despite the marked muscle atrophy and loss of deep reflexes, there was no electrical reaction of degeneration. The patient presented numerous stigmata, such as pigmentation of the skin, hypercholesterolemia, diminished metabolic rate, bilateral cataract, and bradycardia, suggesting a pleuriglandular syndrome rather than an involvement of the basal ganglia. Glycocoll, ephedrine, and thyroid extract were given without any amelioration of the symptoms.—*Henry Milch, M.D., New York, N. Y.*

PATHOLOGIE DE L'IMAGE DE SOI. LES HALLUCINATIONS DES AMPUTÉS. ÉTUDE CLINIQUE ET PATHOGÉNIQUE (Amputation Hallucinations). Jean Lhermitte et Zvonimir Susic. *La Presse Médicale*, XLVI, 627, 1938.

The authors undertook a study of twenty-eight cases in which the patients ranged in age from thirty-nine to eighty years. One or more amputations had been performed from three to forty-six years before the study. Occasionally the patients experienced pain in the amputated extremity at variable times, although localization of pain usually came on directly after operation. The pain appeared to be intensified by fatigue and by change of weather. At night and during sleep, the pain frequently became so severe as to waken the patients.

As a consequence of their clinical analyses and experimental studies by means of calcium-gluconate injections, the authors make a definite distinction between the pain specifically located in the stump and that referred to the amputated extremities. This latter type of pain, contrary to the general opinion, is not due to local conditions in the stump, but is to be referred back to the central nervous system. In the opinion of the authors, this pain can only be understood as a psychological and pathological manifestation of the proprioceptive sense.—*Henry Milch, M.D., New York, N. Y.*

TRAITEMENT DES PARALYSIES SPASMODIQUES. RADICOTOMIE POSTÉRIEURE (Posterior Radicotomy in Treatment of Spastic Paralyses). M. Yovtchitch. *La Presse Médicale*, XLVI, 689, 1938.

The author is of the opinion that, in the treatment of spastic paralyses, the simple procedures should be employed before the more complicated ones are attempted. Apart from reeducation, tenotomy is the most valuable. Osteotomies and joint stabilizations have not been used. The author feels that sympathectomy is of no special value, since it yields only a transitory hypotonia. Stoffel's operation gives only slightly better results than simple tenotomy and should be employed only in the mild cases. For the severe cases, the Förster operation is the method of choice. It gives immediate and lasting relief of the athetosis and the hypertonia. However, since reeducation is an essential part of the treatment, the operation should not be performed unless there is a moderate background of intelligence. The risks and the gravity of the operation have been overestimated.—*Henry Milch, M.D., New York, N. Y.*

INTRADERMIQUES DE SANG DANS LA DOULEUR RHUMATISMALE (Intradermal Injections of Blood for Rheumatic Pain). J. Calvé. *La Presse Médicale*, XLVI, 956, 1938.

Aron and others have noted that intradermal injections, regardless of the material used, exert an analgesic action. By some, this has been attributed to a sympathetic reaction to the injury; by others, it has been explained as being due to the liberation from the tissues of a histamine or a histidine-like substance. This mechanism may explain the results obtained by acupuncture as practised by the Chinese, as well as the success which has followed the use of friction or superficial cautery.

The author has employed this principle in the treatment of rheumatic patients. Autogenous blood was used: first, because autohemotherapy has been shown to have a stimulating effect on the reticulo-endothelial system; and, second, because it seems to intensify the histamine-like action of the puncture. Twenty cubic centimeters of blood are drawn into a syringe containing one cubic centimeter of 10-per-cent. sodium-citrate solution. The skin over the painful joint is disinfected, and several drops of blood are then injected intradermally in a number of spots, from two to three centimeters apart. The remainder of the blood is injected intramuscularly. The injections are repeated every four days.

This method has been used in cases of varied nature, including periarthritis of the shoulder, coxarthritis, lumbago, sciatica, lumbar arthritis, sacro-iliac arthritis, etc. The author reports a number of cases as "cured" (including three cases of chronic rheumatism), several as improved, and one as unimproved.

Although the author is convinced that the injections alone will give satisfactory results, he notes that, in forty-two cases, two cubic centimeters of sulphurated natural oil, containing two and thirty-four one-hundredths centigrams of organic sulphur, were given over a period of from ten to twenty days. The author expresses the opinion that this ensures more rapid results.—*Henry Milch, M.D., New York, N.Y.*

ROENTGEN THERAPY OF DUPUYTREN'S CONTRACTURE. S. R. Beatty. *Radiology*, XXX, 610, May 1938.

The surgical treatment of Dupuytren's contracture is a somewhat formidable procedure; hence, an effective method of treatment which is without dangers and which does not interrupt the patient's routine of living is desirable. There is practically no literature on the treatment of this condition by irradiation.

The author reports the use of irradiation in ten cases, and gives details of the conditions present and of the technique of treatment used.

Seventy per cent. of the treated cases showed very definite improvement; there was marked relief of the contracture in two cases in which the contracture was of an advanced stage.—*Edward N. Reed, M.D., Santa Monica, California.*

HAMMER TOE. THE CUP AND BALL PROCEDURE. A. Tierny. *La Pratique Chirurgicale Illustrée* (Edited by Victor Pauchet, Ed. 2, Paris, G. Doin & Cie), IX, 265, 1937.

This procedure, first described by the author in 1924 and used in about twenty cases, has the advantage of saving the articulations of the toe. The operation is performed

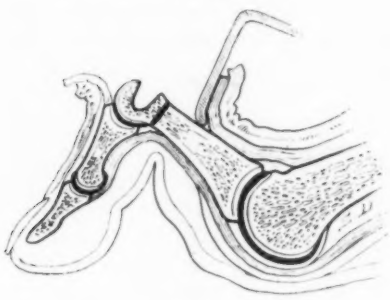

FIG. 1

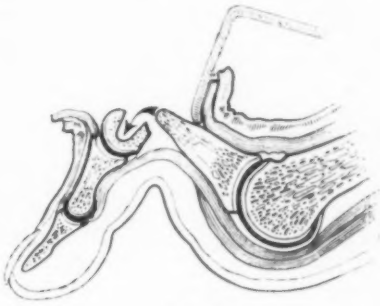

FIG. 2

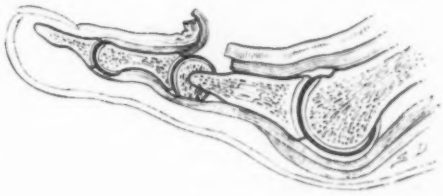

FIG. 3

under local anaesthesia. An elliptical incision is made, with excision of the bursa and skin; the extensor tendon is cut transversely and lifted off the joint; a small hole is bored in the head of the proximal phalanx slightly behind the center of the articular surface; the neck of the phalanx is then severed from the body of the phalanx proximal to the hole; and the cut end of the body of the proximal phalanx is reshaped to fit the hole bored in the head. When completed, the cut surface of the head is directed downward. The cut ends of the extensor tendon are reunited and the wound is closed.

The successive steps of the operation are illustrated in Figures 1, 2, and 3.—*Emanuel Kaplan, M.D., New York, N. Y.*

BONE (CALCIUM) METABOLISM IN RELATION TO INDUSTRIAL INJURY. W. Warner Watkins. *Radiology*, XXXI, 59, July 1938.

The skeleton is considered not simply as a framework for the body, but also primarily as a storehouse for calcium. Bone is not a fixed and stable tissue, but is capable of undergoing rapid and striking changes. Calcium and phosphorus are not inert minerals, whose whole function is to give hardness and stability to bone, but are essential and vital in the general metabolism. Calcium is rapidly removed from the bones when needed elsewhere in the body.

In bone development or repair, calcium is deposited in a preformed connective-tissue matrix; and the more primitive the type of tissue, the more perfect the bone formation.

Bodily needs require a constant level in the blood stream of from nine to eleven milligrams of calcium per 100 cubic centimeters of blood. The intake of calcium must maintain this and provide enough more for osteogenesis and bone repair.

Vitamin D is essential to promote the absorption of calcium from the intestine. Parathormone maintains the calcium level in the blood stream, but it does not influence its deposition in bone. The calcium brought by the blood stream to the bone is changed by an enzyme, phosphatase, into the form which is most easily deposited. Whether phosphatase is secreted by the osteoblasts, and what other function these cells may have in osteogenesis, is not definitely known.

There are various types of bone atrophy, — nutritional or starvation, due to dietary

deficiency; disuse atrophy; senile atrophy; neurotrophic atrophy; and the acute reflex atrophy originally described by Sudeck, which is due to disturbance of the sympathetic-nerve control.

Certain metabolic diseases cause the calcium to be dissolved out of the bones. One of the most striking of these is the so-called "renal rickets", in which failure to eliminate phosphorus by the kidneys causes the withdrawal of calcium from the bones in order that it may combine with and render inert this retained phosphorus.—*Edward N. Reed, M.D., Santa Monica, California.*

TRATAMIENTO OPERATORIO DE LAS FRACTURAS DIAFISARIAS IRREDUCTIBLES DEL ANTEBRAZO (Open Reduction of Irreducible Diaphyseal Fractures of the Forearm). A. F. Gutiérriez Solís. *Revista de la Policlinica Caracas*, No. 37, December, 1937.

In treating displaced diaphyseal fractures in the forearm, perfect function is obtained only with perfect apposition. When satisfactory closed reduction is not obtained, the points of fracture are exposed promptly and the fragments brought in apposition by intramedullary grafts or by suturing with kangaroo tendon or No. 3 chromic catgut. Twenty-three case reports (with photographs) prove the open method advisable.—*Edward Francis Keefe, M.D., New York, N. Y.*

VARIOS ESTANDARTES DE CIRUGÍA DE GUERRA (Some Standard Treatments of War Surgery). M. Bastos. *Revista de Sanidad de Guerra*, September and November 1937.

For gunshot fractures of the arm, the author employs a method which prevents systemic complications, severe osteomyelitis, gangrene, and pseudarthrosis. Wounds of the soft parts are thoroughly cleansed, but are sutured only in cases where stretching of the surrounding skin is not necessary. Bone fragments should never be removed, even when they appear to be dislodged. The arm is immobilized in a plaster cast, in 45 degrees of abduction, with the elbow at a right angle and the wrist extended. The author warns against putting the arm in a horizontal position, as well as against the application of extension: first, because of possible healing of the humerus in a curved position; and, second, on account of the risk of non-union. The plaster remains unchanged for from four to eight weeks; after this time, a new cast is applied. As soon as roentgenograms show bony union, the cast is removed, and the patient starts to move the shoulder.

Amputation should never be done if circulatory conditions are good. The lack of pulse at the wrist is not a conclusive symptom; immediate amputation is indicated only if the hand is cold and gray in color and shows clear signs of gangrene.

In cases of wounds of the main vessels of the limbs, the author states that ligature results in no ill effects in the arm, because there circulatory disturbances are of no importance. In the leg, on the contrary, the consequences of ligature are most unfortunate, for gangrene usually follows. For that reason, the author performs systematic amputation in such cases.—*Francisco P. Dueño, M.D., Madrid, Spain.*

CONTRIBUCIÓN AL ESTUDIO DE LA PATOLOGÍA DE LAS FRACTURAS RECIENTES DEL CUELLO DEL FÉMUR Y LOS FUNDAMENTOS DEL TRATAMIENTO OPERATORIO DE ESTAS FRACTURAS (A Contribution to Pathology and Surgical Treatment of Recent Fractures of the Neck of the Femur). J. y M. D'Harcourt. *Revista de Sanidad de Guerra*, June 1937.

Recent fractures of the neck of the femur without dislocation of the fragments should be treated by non-operative methods. Abduction fractures with penetration of the fragments ought to be fixed in a Whitman plaster spica. When manipulation does not succeed in coapting the fragments and keeping them together, operative treatment should be employed. The authors advocate the use of the Smith-Petersen or the Felsenreich nail. The operation is performed after the technique of Sven Johansson,—that is, the wire is inserted and check-up roentgenograms are taken before the nail is definitely fixed in place.—*Francisco P. Dueño, M. D., Madrid, Spain.*

CONSIDERACIONES SOBRE EL TRATAMIENTO DE LAS HERIDAS DE GUERRA DE LA MANO (Considerations on the Treatment of Gunshot Wounds of the Hand). V. Sanchís. *Revista de Sanidad de Guerra*, August 1937.

During the first twelve hours, all destroyed tissues are removed and the skin wound is sutured without drainage. After this period the author advocates mechanical cleansing of the wound and open treatment. The extensor tendons are sutured when it is possible. The accompanying fracture of one or more metacarpals is reduced and the wrist is immobilized in a "cock-up" plaster splint. A wire splint is used for the extension of the digits in the flexed position.—*Francisco P. Dueño, M.D., Madrid, Spain.*

LE FIBRO-CARTILAGE DE L'ARTICULATION RADIO-CUBITALE INFÉRIEURE CHEZ L'ADULTE (The Fibrocartilage of the Inferior Radio-Ulnar Joint in the Adult). J. Guillermo. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXV, 125, March 1938.

The author calls attention to the fact that injuries to the discus articularis produce painful arthritis and limitation of pronation and supination. These injuries are associated with fractures of the wrist, or they may be present without accompanying bone fractures. The anatomy, physiology, and pathology of this important but overlooked ligament are described. A clinical picture of a lesion is presented. The author compares this fibrocartilage to the meniscus of the knee. The treatment recommended by the author consists in complete removal of the discus articularis under local anaesthesia.—*Emanuel Kaplan, M.D., New York, N. Y.*

FRACTURE DU TRAPÈZE (Fracture of the Greater Multangular). Fernando de Moraes. *Revue d'Orthopédie et de Chirurgie de l'Appareil Moteur*, XXV, 217, May 1938.

The newer notions of anatomy of this region are given, and a minute analysis of the mechanism of fractures of the greater multangular is presented. The treatment is prolonged immobilization after reduction by continuous traction applied to the thumb in abduction. The author believes that if this treatment is not effective the removal of the bone is the method of choice.—*Emanuel Kaplan, M.D., New York, N. Y.*

ANOTHER METHOD OF PINNING FRACTURES OF THE NECK OF THE FEMUR. Joseph Madison Greer. *Southwestern Medicine*, XXII, 213, June 1938.

The author calls attention to the greater incidence of healing in impacted fractures of the femoral neck as compared with the cases where impaction is not present. He notes that most nails, wires, and other fixation devices used in femoral-neck fixation do not maintain impaction for the entire duration of the time necessary for the fracture to become firmly healed, as the friction between the bone and the metal becomes lost with bone absorption about the metal fixation device. Accordingly he has devised a screw that will maintain solid impaction for the duration of the healing period. This screw, the end of which is a modified corkscrew, is designed to rest entirely within the capital fragment. It presents a broad surface at almost right angles to the capital axis and thus affords a firm anchorage for strong traction and for compression or impaction. The screw penetrates easily without previous drilling and without displacement of the fragments. When the screw is in place, the trochanter fragment is forced against the head fragment by means of a trochanter catch, which prevents rotation of the screw and maintains effective impaction. The technique for inserting this screw is as follows:

1. Reduce the fracture by the Leadbetter method.
2. Take roentgenograms in two views.
3. Prepare and drape the patient on a fluoroscopic table for operation.
4. While viewing the area through the fluoroscope, hold one point of the forceps over the center of the head and another just below the base of the trochanter where the screw is to enter the femur.

5. Mark these two points with a dye and draw a line between them.

6. Make an incision over the trochanter, and insert the screw parallel to the table top and along the line drawn on the skin. Be sure that the leg is in internal rotation.

7. Take a roentgenogram to be sure that the screw is going in properly; then screw it all the way in, put the lock catch and nut on its shank, and screw down tightly.

This procedure is simple, can be done rapidly, and the end results are excellent.—*Herbert E. Hipps, M. D., Marlin, Texas.*

TREATMENT OF DISLOCATION OF THE SHOULDER. Henry Milch. *Surgery, III*, 732, May 1938.

The author cites a case of spiral fracture of the humerus occurring during Kocher's manipulation for dislocation of the shoulder. He advocates the use of a method which he calls "abduction, external rotation, and pulsion", not only for the uncomplicated acute dislocations but also for fracture-dislocations as well. Reduction may often be accomplished without the use of an anaesthetic.

The patient lies in the supine position, while the surgeon takes his place on the side of the dislocation. In a right-sided dislocation the surgeon places his right hand upon the patient's right shoulder, so that the fingers find firm support on the top of the shoulder, while the thumb is braced against the dislocated humeral head. The right hand fixes the head while the left hand gently abducts the arm into the overhead position. During this manoeuver the head of the humerus is supported so that it cannot move from its dislocated position. As a consequence, instead of moving downward as the arm moves upward, the head rotates in place. In this manner the tendency to stretch further already stressed nerves is obviated. As the arm is abducted, it is gently rotated externally to release the twisted capsule, according to the principles described by Kocher. Once the arm has been brought into complete abduction in this overhead position, all cross-stresses exerted by all the muscles have been eliminated, and the head can be gently pushed over the rim of the glenoid and the dislocation reduced.

THE RELATIONSHIP OF THE INTERVERTEBRAL DISK TO BACK STRAIN AND PERIPHERAL PAIN (SCIATICA). Joseph S. Barr. *Surgery*, IV, 1, July 1938.

The author reports fifty-eight cases, from the Massachusetts General Hospital, of posterior protrusion of the intervertebral-disc tissue into the lumbar spinal canal in which there was pressure on one or more roots of the cauda equina. The patients complained of intractable leg pain involving the posterior thigh, lateral calf, and sometimes the low back or foot. On examination, the characteristic findings of "low-back strain with sciatic scoliosis" were usually present. The lumbar spine was flat or kyphotic with a fixed list to one side. Straight-leg raising was limited chiefly on the side of the pain. In many cases there was tenderness at the lumbosacral junction or at the next higher spinous interspace. The neurological findings varied from negative to those of complete flaccid paraplegia. An absent or diminished ankle jerk was the most common finding.

The ordinary roentgenograms were of little use in diagnosis, but fluoroscopic examination after the injection of lipiodol localized the lesion with a very high degree of accuracy. The author emphasized the necessity of considering this diagnosis in every case of sciatica and back strain, but reserved the use of lipiodol for those cases which showed obvious signs of nerve-root pressure or which had failed to improve under adequate conservative treatment. Laminectomy and removal of the protruding disc tissue gave relief in all but three of the fifty-eight cases. There was one operative death.

THE SURGICAL TREATMENT OF LOW BACK PAIN. Alan DeForest Smith. *Surgery*, IV, 13, July 1938.

About 90 per cent. of all patients admitted to the Clinic of the New York Orthopaedic Dispensary and Hospital with the complaint of pain in the low back were relieved

by non-operative measures, about 5 per cent. were subjected to lumbosacral fusion, and the remaining 5 per cent. refused operation. The author stressed the necessity of eliminating the cases of spinal-cord tumor, arthritis, etc., by a thorough physical examination.

Mechanical insufficiency at the lumbosacral articulations was considered to be the cause of symptoms in most of the cases. The sacro-iliac joints were considered to be at fault very rarely.

Changes in the lumbosacral angle, abnormal lateral articulations, posterior displacement of the fifth lumbar vertebra on the sacrum, defects in development of the laminae, sacralization of the transverse processes, and degeneration of the lumbosacral intervertebral disc were among the most common predisposing factors found.

The Hibbs type of fusion, occasionally using additional bone from the ilium, was employed in all cases. In the majority of cases the fifth lumbar vertebra and the sacrum only were fused.

Excellent or good results were obtained in between 80 and 90 per cent. of a "large series" of these cases treated by lumbosacral fusion. Failures were due: first, to non-recognition of the presence of arthritis; and, second, to inability to obtain fusion.

In cases of low-back strain with sciatica, division of the fascia lata alone or in combination with spine fusion gave excellent results.

Relation of the Fascia Lata to Mechanical Disabilities of the Spine. Frank R. Ober. *Surgery*, IV, 21, July 1938.

The author reviewed and discussed in detail the anatomical relationship of the fascia lata to the muscles and bones of the junction of the thigh and pelvis. He pointed out that fascial contractures accounted for certain physical variations; i.e., increased lordosis, limitation of straight-leg raising, pelvic tilt, etc. Certain cases of chronic lame back and sciatica were associated with fascial contractures and were relieved by stretching or by division of the tight structures. Fasciotomy was reserved for those cases in which other organic lesions were excluded.

Surgical Treatment of Affections of the Lumbosacral and Sacro-iliac Joints. Joseph I. Mitchell. *Surgery*, IV, 33, July 1938.

In this article, the late Dr. Mitchell enumerated the causative agents affecting the spine and producing low-back pain, in order of frequency, as follows: (1) infection, (2) congenital anomalies, (3) trauma, (4) postural defects, (5) tumors. He discussed briefly the differential diagnosis of lumbosacral and sacro-iliac affections and described the technique (Campbell) of extra-articular fusion of the sacro-iliac joint. In certain cases fusions were combined by laying grafts between the ilium, the sacrum, and the transverse process of the fifth lumbar vertebra. He reported excellent results in 77 per cent. of the non-tuberculous cases and in 61 per cent. of the tuberculous cases.

Gibt es eine dem Morbus Köhler II analoge Affektion auch am Köpfchen des Os metatarsale I? (Is There a Köhler's Disease of the Head of the First Metatarsal?) Heinrich Breitenfelder. *Zeitschrift für Orthopädie und ihre Grenzgebiete*, LXVI, 181, 1937.

Köhler's disease of the heads of the second, third, and fourth metatarsals has frequently been described. The fifth metatarsal does not seem to be affected at all, and the first metatarsal only rarely. This has been attributed to the protection given by the two sesamoid bones. Typical necrosis of these sesamoid bones has been described. Other authors consider the arthritis juvenilis of the basal joint of the hallux (the hallux rigidus) to be related to Köhler's disease. The author then describes a case of Köhler's disease of the first metatarsal, basing the diagnosis upon the roentgenographic appearance as compared with roentgenograms of Köhler's disease of other metatarsals.—*D. H. Bruns, M.D., Iowa City, Iowa.*

EIN BEITRAG ZUM KRANKHEITSBILD DER VERTEBRA PLANA CALVÉ [Vertebra Plana (Calvé)]. W. Marquardt. *Zeitschrift für Orthopädie und ihre Grenzgebiete*, LXVI, 343, 1937.

Bülow and Hansen, in 1924, reported a case of Köhler's disease of a thoracic vertebra. Calvé also described a case in 1924. Twenty-seven cases have been reported to date. The author has observed a similar case of six years' duration. A boy of four years became suddenly ill with abdominal pain and backache. A small gibbus was found, and the roentgenogram showed a typical vertebra plana.

Sundt studied twenty-one cases and found that the patients ranged in age between two and fifteen years, most of them being five years old. The onset was usually acute, with severe abdominal pain. A small gibbus or kyphos, with muscle spasm and pain in that region, was found. There was no elevation of the temperature nor appreciable change in the blood picture. Roentgenographic examination in each case showed the vertebra flattened to a small disc and dense. In either projection the edges seemed to bulge over the neighboring intervertebral disc. The intervertebral discs showed normal height. In the course of months or of one to two years the vertebra revascularized and increased in height, although it usually never attained more than one-half of its normal height. In a few cases neurological pathology (compression) was present. Treatment consisted in recumbency and the application of a brace.—*D. H. Bruns, M.D., Iowa City, Iowa.*

DIE HEILUNG VON HABITUELLER SCHULTERLUXATION UND KREUZBANDRUPTUR DES KNIEGELENKES MITTELS EIGENBLUTINJEKTIONEN (The Treatment of Habitual Dislocation of the Shoulder and Rupture of the Cruciate Ligaments of the Knee with Autogenous Blood Injections). Felix Mandl. *Zentralblatt für Chirurgie*, LXIV, 1030, 1937.

The operative reconstruction of cruciate ligaments in the knee in cases of traumatic rupture of the cruciates is a very formidable procedure, which has been completely abandoned by the author. Instead he obtains about ten to twenty cubic centimeters of whole blood from the cubital vein of the patient and injects it into the joint capsule of the knee. This injection is repeated from five to ten times at intervals of from two to three days. Since July 1935, the author has injected sixty-four knees, with complete disappearance of the "drawer" symptom and restoration of joint stability in 75 per cent. of the cases. In those cases of rupture of the cruciate ligaments where there are additional injuries that require operative procedures, the blood is introduced into the capsule through the operative wound. There were no complications following these injections except an occasional hyperaemia in the region of the knee joint, which always disappeared in a short time.

These injections have also been used successfully in a number of cases of habitual dislocation of the shoulder in which operative intervention was contra-indicated. These intracapsular injections bring about a shrinkage and contracture of the capsule, which becomes firm and strong enough to maintain the stability of the joint.—*Harold Unger, M.D., Iowa City, Iowa.*

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